MATERIALS AND METHODS IN HIGH SCHOOL AGRICULTURE

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MATERIALS AND METHODS IN HIGH SCHOOL AGRICULTURE

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PREFACE

Much is being said and written in these days as to agricultural education. It is being conceded that we need and must have more agricultural and other vocational instruction in our public schools. The Universities provide higher instruction in agriculture in admirable ways. Fairly satisfactory outlines and teaching methods have been worked out for agricultural instruction in the elementary schools. In the secondary schools, however, agricultural teaching is in a very chaotic condition.

High schools located in agricultural communities or in towns or cities depending largely upon agriculture for their prosperity should provide agricultural courses. As to the number or nature of these courses there is little agreement. Ideas regarding the proper materials and methods to be employed in teaching agriculture in the high school lack clearness, definiteness, and pedagogical foundation.

The average university trained agriculturalist, going out to teach, has little understanding of the exact nature of the agricultural work which should be given in the high school, or as to methods of presenting

it. The pure science man, to whom the agricultural teaching is frequently delegated, has still less.

This book has been prepared to meet the needs of persons interested in the introduction or in the teaching of agriculture in high schools of towns, cities, or rural communities where large numbers of students are drawn from the farming population, or where the prosperity of the high school community is largely dependent upon agriculture.

It is the result of the experience of one of the authors in teaching agriculture in such high schools, and of extended observation and comparison of high school agricultural courses and methods by both authors. Numbers of schools have been personally visited, and correspondence has been carried on with many others.

The purpose of the book is to outline the agricultural course, as a whole, for high schools of the type mentioned, and to give helpful suggestions as to the selection of suitable materials, teaching methods, and equipment for the various subjects of the course.

The materials and methods outlined have been, for the most part, personally used and tested by W. G. Hummel in his work in the high school. The gathering of part of the material and the preparation of much of the manuscript has been the work of B. R. Hummel. The chapters of the book, written after experience and careful investigation and study, have

been used and revised in connection with the teaching of university classes in high school agricultural methods. The practicums and references for collateral reading following each chapter were prepared especially for such classes.

The thanks of the authors are due to Professor Maurice A. Bigelow, Professor of Biology in Teachers College, Columbia University, for reading of the manuscript and helpful criticisms and suggestions; and to Professors E. B. Babcock and Alexis F. Lange, of the University of California, for reading of part of the manuscript and for helpful criticism.

W. G. H.
B. R. H.

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CHAPTER I

AGRICULTURE IN THE HIGH SCHOOL: WHAT IT IS AND SOMETHING OF ITS HISTORY

BEFORE entering upon a discussion of methods of teaching agriculture in the high school, we should have a definite understanding as to the scope and purpose of high school instruction in agriculture and we should know something of its history.

The object of agricultural work in the elementary schools is, it is agreed, to give correct ideas of environmental materials; "to get a wide, intelligent, and sympathetic acquaintance with the more evident things of nature and man's relation to them." [1] It is not the purpose of agricultural work in the elementary schools to make farmers; but to open the minds of children to the common phenomena of nature, to inculcate habits of observation, and to generate in children high ideals of country life. It should be the aim of the work to awaken and cultivate an interest in and respect for industry in general and for the life and work of the farm in particular. It should "cultivate the active and creative instincts as distinct from the reflective

[1] Bricker, G. A., "Teaching of Agriculture in the High School," p. 3.

and receptive,"[1] which have hitherto been almost exclusively exercised in our schools. There should be given, in the lower grades, such an experience with and knowledge of the more common things relating to plants, animals, soils, etc., as will form a practical working basis for future instruction in more specific studies in agriculture proper when the child reaches the upper grades and the high school. Throughout the elementary school the work should give practice in failure and success, thus putting to the test early in life the ability to do definite things; it should connect the school work with real life and thus make the value and need of schooling more apparent.

Agriculture in the elementary schools has been well defined as nature-study with an economic significance. It is nature-study which emphasizes utility and stimulates industry.

The work of the colleges has heretofore included much agricultural instruction properly of secondary rather than of college grade. The true province of the work in these higher institutions lies in the investigation and study of the more fundamental problems of agricultural science and practice. It should emphasize experimental and research work and the study of agricultural theory. When, as seems inevitable sooner or later, the high schools take up everywhere those phases of agricultural

[1] Davenport, E., "Illinois Course in Agriculture."

teaching adapted to them, the universities and colleges will be enabled to drop many of the more elementary courses which they are now giving and to concentrate on more advanced work.

The work of the secondary schools, as is evident, lies between that of the colleges and the elementary schools. Its purpose differs from that of either of these. High school agriculture should be practical agriculture, educating students for the business of farming. And yet it should not be narrowly vocational, but should be cultural and disciplinary as well. It should not only prepare students to be good farmers, but should fit them for life as broad-minded, intelligent, progressive citizens. The agricultural instruction given should include the scientific principles underlying the farming industry, the observation of agricultural methods and results in fields, orchards, flocks, and herds, and experiment and practice in the laboratory and on the school agricultural grounds.

In the general high school the work will of course be less comprehensive than in the technical high schools, special private secondary schools, etc.; but it should in all cases be practical, usable agriculture, giving a thorough grounding in the elementary principles of agriculture, with practical laboratory and field work. In addition, it is desirable that the courses in agriculture be so organized as to form a natural and proper preparation for entrance to the agricultural colleges.

The graduate of the high school agricultural course should understand the rational and scientific basis of modern agriculture and should appreciate its needs. He should be able and alert to profit by the results of experiment station and government investigational work so far as it relates to his own problems; and he should be fitted to judge and to select from agricultural information, however offered, whether by other farmers, by books, bulletins, or periodicals, whatever will be useful and profitable to him. If he is to engage in farming immediately after completing his high school course, he should take to his work from the school, together with valuable information, an appreciation of the dignity of his work, of its possibilities, and of its problems. If he goes on to the more advanced work of the college, he should take with him a knowledge of elementary facts and principles and an eagerness for study and investigation of the many problems which he knows are forcing themselves upon the attention of those interested in agriculture.

Having indicated the function of agriculture in the high school, we may review its history briefly. It is, however, a difficult matter to bring the history of agricultural teaching in high schools up to date, — to keep pace with the spread of the movement for secondary instruction in this country. Even the experts in agricultural education of the Office of Experiment Stations

at Washington, with their special facilities for gathering information, confess their inability to keep a complete record of progress.

The first successful agricultural high school was established in connection with the College of Agriculture of the University of Minnesota in 1888, — twenty-five years ago. Agricultural secondary schools are now connected with agricultural colleges of nearly forty states. According to the latest available statistics,[1] over eighty distinctly agricultural high schools of different types have been established since 1888. Almost all of these are supported wholly or in part by state funds. In addition, at least 289 public high schools are receiving state aid for agriculture, and over 1600 unsubsidized public and private high schools and academies are giving instruction in agriculture. Among other secondary institutions giving instruction in agriculture are a considerable number of privately endowed schools; and nearly 200 state and county normal schools are undertaking to prepare young people to teach agriculture.

Of the separate agricultural high schools receiving state aid, there are several types, chief among which may be mentioned the congressional district agricultural high schools and the country agricultural high schools. Alabama was the first state to establish an agricultural

[1] "Experiment Station Record," March, 1912. Editorial. Office of Experiment Stations Cir. 106, rev. Oct., 1912.

school in each congressional district. Georgia followed in 1906. In 1908 Virginia provided an appropriation of $25,000 for instruction in agriculture and other industrial subjects in one high school of each congressional district. In 1909 Arkansas provided for the establishment of an agricultural school in each of the four educational districts of that state; and in Oklahoma, at an earlier date, an agricultural high school was provided for in each judicial district.

County agricultural high schools are now in operation in a number of states. They were first established in Wisconsin, in 1902. In that state the schools are equipped at the expense of the counties where they are located, but they receive $4000 per year to aid in paying running expenses. The Marathon and the Dunn county schools were the first established and have achieved national reputations. During the past few years other schools having similar courses have been established in other Wisconsin counties. In 1905 Minnesota passed an act providing for local option in the establishment and maintenance of county high schools of agriculture and domestic science, and in 1907 Michigan passed a like law. In Mississippi a law was passed in 1908 for the establishment of county agricultural high schools, with state aid of $1000 annually. In Michigan county agricultural high schools were authorized in 1907. Other states have quickly followed, and the establishment of

county agricultural high schools is now authorized in at least twenty-three states.

Besides the county and congressional district high schools in the various states there are, in certain states, special separate agricultural schools of secondary grade, wholly or in part state supported. The California Polytechnic School at San Luis Obispo is an example of these. The New York State schools at Canton and Morrisville, the Massachusetts school at Petersham and the Smith agricultural school at Northampton, and others in various states, are similar, though not all offering work of like grade.

Special provision is made in various states, notably Minnesota, for the introduction and support of agriculture in consolidated rural or township schools; and in certain states provision is made whereby state aid is given to all existing public high schools introducing agriculture. There are also many private schools of secondary grade giving instruction in agriculture, as the Mount Hermon school, at Northfield, Mass., the Winona agricultural college, at Winona Lake, Ind., and others. Besides these, the normal schools all over the country are introducing agricultural work, and practically all the Indian and Negro schools of secondary rank give agricultural courses.

Lastly, there are the many ordinary high schools of the country not receiving state aid, but which have in-

troduced agriculture into their curricula, supported by their communities. These are rapidly increasing in number, and excellent work is being done in many of them.

In the majority of these locally supported high schools, and in all partly or entirely state supported high schools, agriculture is taught as a separate subject. In a considerable number of high schools, however, agriculture is taught only incidentally, in connection with the other sciences. In this connection it is interesting to note that the smaller high schools lead in teaching agriculture as a separate subject, presumably because located in close connection with agricultural communities. In the very large high schools where agriculture is taught, it is frequently only as applied science.

Some of the great state universities are urging the placing of agriculture in all the high schools already established; others are urging the establishment of separate agricultural high schools. Each plan has its special advantages and disadvantages. It is argued against the separate secondary agricultural school that "to segregate any class of people from the common mass and to educate it by itself and solely with reference to its own affairs, is to make it narrower and more bigoted, generation by generation. It is to substitute training for education."[1] It is said, and very truly, that "our

[1] Davenport, E., "Education for Efficiency," p. 105.

young people need to be educated and trained together so that those who are preparing for certain modes of life shall come in contact with others who are preparing for different modes of life and so acquire sympathy for other vocations besides their own. Boys and girls will thus have opportunities for developing tastes and modes of life for which they are best fitted, and which otherwise they would entirely miss."[1] Moreover, it is impossible, even if it were desirable, for the majority of our boys and girls to leave home to go to these special agricultural schools. Whatever instruction they get must be in the local schools.

On the other hand, there is a legitimate place for some of these special secondary schools of agriculture. They have already performed valuable work and will continue to do so. They have stimulated the introduction of agriculture into the ordinary high schools, and, in a general way, will set the pace for them.

To be most effective they should serve comparatively large districts,[2] several counties preferably, that there may be ample provision for their equipment and support and that they may draw a sufficient number of students. They will then serve a most valuable purpose in our scheme of agricultural education. To them may go

[1] Bricker, G. A., "Teaching Agriculture in the High School," p. 41.

[2] Crosby, D. J., "The Place of the Agricultural High School." National Education Association, Proceedings, 1910, pp. 1103–1107.

those boys and girls who do not live where there is a local high school giving agricultural instruction, or who desire a more specialized training than the regular high school can give, yet who cannot go to college. Here instruction may be given for farmers and others who by reason of maturity or business demands desire, through special courses, to gain as much information as possible in a short period. The colleges will thus be relieved of much of the short and special course work which they are now compelled to give, often to the detriment of their regular instructional and research work. And the farmers will be helped quite as effectively. Farmers living at a distance from the agricultural college will often be enabled to attend short courses at such schools when they could not at the college. Experiments and demonstrations directly related to the special problems of the particular district may be carried on at the school farm under conditions similar to those with which the farmers of the district have to deal. Valuable extension work may be done among the farmers, and the influence of the school may be made evident in the agricultural work of the schools of the entire section.

There are, then, as we see, various ways and means in agricultural education in the secondary schools. Opinions differ as to just the best kind of secondary agricultural instruction. But all over the country school

men are agreed as to one point, — that agricultural instruction should be included in the curricula of the high and other secondary schools, in one form or another. And all over our own country, and in Europe as well, the schools are introducing it.

PRACTICUM

Using all available sources of information, outline the history of agricultural education in your own state.

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CHAPTER II

THE REASONS FOR INTRODUCING AGRICULTURE IN HIGH SCHOOLS

As stated by Dr. A. C. True, of the United States Office of Experiment Stations, the claims of agriculture to a place in our public school system are based not only on the social, economic, and educational needs of agriculture and agricultural people, but on the pedagogic requirements of a school system which shall be adapted to the masses of the people in a democratic and industrial state, and the symmetrical culture of the mind and body of the human child. Intelligent farmers and members of the teaching profession now "meet on a common platform and, each party using the arguments appropriate to his calling, agree that agriculture is a fit and useful subject to be taught in public schools." [1]

We may, then, well sum up the reasons for teaching agriculture in the high schools under two heads: (1) arguments for agricultural teaching advanced by farmers and others interested in agriculture; (2) arguments for agricultural teaching advanced by school men.

[1] True, A. C., "Why Friends of Agricultural Progress believe that Agriculture should and will be taught in the Public Schools." University of California Cir. 17, p. 1.

Let us review briefly the arguments advanced by the farmer and interested citizen.

It is said, first, that a valid reason for teaching agriculture is that agriculture is a great and fundamental industry. "On the successful prosecution of agriculture depend the continued existence and prosperity of the whole human race. By agriculture we are all fed and clothed and, in a large measure, are provided with dwellings and the material comforts of civilization." [1] There are more than six million farms in the United States, on which over ten million men work for the support of a rural population of over forty million. That is, fully one-third of our population is engaged in agriculture. In addition, over three million persons engaged in manufacturing industries depend upon farm products for their raw material.

The number of persons engaged in agricultural pursuits, the amount of our territory used for agriculture, the variety, amount, universal use, and value of agricultural products, all demand that agriculture should be given a place in our public schools.

Moreover, agriculture will always be the chief business of our country if we are to exist and prosper as a nation. As was well said by former President Roosevelt: "If

[1] True, A. C., "Why the Friends of Agricultural Progress believe that Agriculture should and will be taught in the Public Schools." University of California Cir. 17, p. 2.

there is one lesson taught by history it is that the permanent greatness of any State must ultimately depend more upon the character of its country population than anything else. No growth of cities, no growth of wealth, can make up for a loss in either the number or the character of the farming population. In the United States more than in almost any other country we should realize this and should prize our country population. When this nation began its independent existence it was a nation of farmers. The towns were small and were for the most part mere sea-coast trading and fishing ports. The chief industry of the country was agriculture, and the ordinary citizen was in some way connected with it. In every great crisis of the past a peculiar dependence has had to be placed upon the farming population, and this dependence has hitherto been justified. But it cannot be justified in the future if agriculture is permitted to sink in the scale as compared with other employments."[1]

In agriculture lies the prosperity of a nation and in country life we rightly expect to find much of its health and vigor rooted. But if our agriculture is to be what it should be, if it is to keep pace with the improvements

[1] Roosevelt, T., "The Man who works with His Hands," p. 6. (Address at the semicentennial celebration of the founding of agricultural colleges in the United States, at Lansing, Michigan, May 31, 1907. Printed as Office of the Secretary Cir. 24, U. S. Department of Agriculture.)

in other industries, and to grow with them, country people must be put in sympathy with their work, must be trained and educated in terms of agriculture and country affairs.

Advancement along agricultural lines has not hitherto kept pace with the advancement along other lines. The American farmer has great educational needs. Many economic and social questions of vast importance to the agriculturist demand that he be educated along the lines of his work. If American farmers are not to sink to the level of the peasants of Europe, they must be better educated in the business of farming. The farmer of to-day must be a more intelligent and a better informed man than his predecessor to compete with men in other lines of work and to secure adequate returns for his labor and capital. It has been proved that agricultural instruction increases the financial success of the agricultural worker. Education counts for greater income in this as well as in other occupations.

The workers in our agricultural experiment stations and in the national department of agriculture have discovered facts of the greatest importance to farmers; yet these new truths are very slow in reaching the farmers and are very tardily taken advantage of. Though these new facts are printed in bulletins and circulars, and reprinted in various papers, yet many farmers do not hear of them. Moreover, even when farmers read the pro-

gressive agricultural papers and are on the alert to secure bulletins of experiment stations dealing with their problems, frequently it is very difficult for them to apply what they read. A farmer who has all his life been farming according to some arbitrary rules of his father or of his neighbors, cannot easily adjust himself to scientific methods whose application depends upon a knowledge of conditions of which he is ignorant. He has not been educated in terms of agriculture, and, with his scant knowledge of the basic principles underlying his art, he finds it impossible to apply properly directions as to practice.

As expressed by David Felmley, President of the State Normal School at Normal, Illinois, "It is evident that the agricultural experiment station will never accomplish its purpose unless there is diffused among our farming population an elementary knowledge of the sciences relating to agriculture."

It is to the public schools that we must look largely to make this basic information common and to lay the foundation for an understanding of the facts won from study, research, and experimentation at the colleges and stations. While doing all we can for the adult farmer, we must, if we are to have a well-informed, progressive agricultural population, begin with the farmers and the farmers' wives of to-morrow and instruct them concerning the elementary principles of agriculture

Exhibit of Garden Products of a Class in Beginning Agriculture, Oxnard (Cal.) High School.

in the schools. It is possible for but few of our future farmers to go to the agricultural colleges. The elementary and secondary schools must provide the agricultural instruction for the masses of the farmers. They must do this not only because the successful farmer needs a knowledge of certain facts, but that through his understanding of basic principles, acquired in the school, he may be prepared to comprehend future agricultural discoveries and to apply them.

The American population is increasing by leaps and bounds. Every year millions of foreigners are added to our native-born population. To continue to support this vast and constantly increasing population through the years to come, American farmers must study and use the best and most scientific methods of production. We have already depleted our natural stores of fertility and agricultural wealth in this country by careless and wasteful methods in farming. Our farmers must learn to conserve and build up our resources as well as to exploit them. We can bring comparatively little new land under cultivation. Our farmers must learn to use what they have to better advantage. They must learn to care for and to use their soils properly; to plant the crops best suited to their varying conditions; to raise live stock more economically and with better results; and to market their products to the best advantage of both producer and consumer.

The great problem of modern agriculture is, while increasing production, to conserve and enrich our soil resources; to grow larger and better crops and still maintain the soil fertility. The solution of the problem lies in agricultural education. And this education, for the great mass of farmers, must be given in the public schools.

At present half our total exports are agricultural products of one kind or another. Our farmers need good markets abroad in order to reap satisfactory returns from their crops. But in many foreign countries they are now educating the children along agricultural lines in the schools, and the adults in special schools or under traveling teachers. And because of this the European farmers in such countries are being enabled to compete with our farmers in spite of our vast area and special advantages. For example, the Danes receive $8,500,000 a year more for their bacon, butter, and eggs than England pays to other countries for the same amount of such produce, although twenty years ago, before the children of Denmark were generally taught about such things, the Danish products received less than the usual market price.[1]

Professor McKay, of the Iowa Agricultural College, found that this Danish butter brings two to three cents

[1] Jewell, J. R., "Agricultural Education," p. 116. U. S. Bureau of Education Bul. 2, 1907.

a pound more in England than any other butter, because of its dry, mealy appearance. Yet investigation showed that the butter actually contained 2 to 3 per cent more water than American or Canadian butter. So that the Danes get two or three more pounds of butter to each one hundred pounds of butter fat than we do, and yet sell it for two to three cents a pound more. The explanation is that the Danes have found the secret of making butter containing this extra amount of water appear to be extra dry, and the process is taught in the Danish schools.

European farmers buy our entire surplus of cotton seed very cheap and feed the meal to their cattle, while many of our Southern farmers do not yet fully recognize the value of cottonseed meal as a fattening product and use it very little if any, although its value was demonstrated at the University of Tennessee Experiment Station very thoroughly a few years ago.

Reports of the Bureau of Statistics of the United States Department of Agriculture show an average excess per acre abroad over production in the United States of 127 per cent for wheat, 97 per cent for rye, 36.8 per cent for oats, 30 per cent for barley, and 93 per cent for potatoes. And there is little doubt that an important factor in this increased average production per acre by foreign countries over the United States is the systematic method pursued by these countries in agricultural education.

Nor is it the prosperity of our farming districts and states alone that demands agricultural training for our future farmers. Successful agriculture is essential to the prosperity and well-being of urban as well as rural communities. The welfare of our cities and of our great manufacturing states depends, to no small extent, upon our agricultural prosperity. All over the country the prosperity or poverty of rural communities influences the life of the towns and cities near at hand. If the abandoned farms of New England could be made productive and economically valuable, they would be of inestimable value to the factory employees of the towns of the region. All over the South, city conditions would be greatly bettered if the productiveness of the surrounding country were increased. And that this is not impossible, but a task readily accomplished, has already been shown by the work of the late Dr. Seaman A. Knapp among Southern farmers. Better education of the owners and renters of farms in methods of caring for their land and their crops will increase their productivity and their prosperity.

Many towns and cities of the United States are entirely dependent upon the agricultural territory surrounding them for their commercial prosperity, and even for their very existence. It is not only a matter of wise forethought for the high schools in such towns to provide courses in agriculture, it is a matter of right and justice.

Such schools are supported largely by agriculture and should seek to promote, in the instruction which they offer, the interests of the industry to which they owe so much. The farmers of the surrounding communities do not expect that all the children who go to such schools should develop into farmers, but only that, along with the other instruction, children be given an opportunity to find out that there is in agriculture, as in other occupations, something worthy the best intellect and the best talent.

All these are arguments from the agricultural standpoint. From the educational standpoint there are still other reasons why agriculture should be taught in the public schools, particularly in the high school.

It is evident that in a truly democratic nation there must be equality of educational opportunity for all children. Our free public schools have from the first been open to all classes and have offered opportunity for the continuous mental development of every child to and through the higher institutions of learning. We have therefore prided ourselves on a school system offering equality of educational opportunities to all. But that this pride was based on a fallacy and that our school system did not offer this equality of opportunity became evident some years ago. Secondary and higher education, particularly, have been largely confined to the needs of a particular class of people. Education in this country has been universal, but narrow and undiversified.

In an undeveloped state of society the narrow, fixed course of study is natural and perhaps desirable. The inefficient many subject themselves to the efficient few; education is confined to the upper classes, and is restricted in variety.

But in the complex, highly developed social and industrial conditions of our modern state, a diversified system of education is demanded. Pupils come into the schools from all grades of society, rich and poor, from the homes of the mechanic, the artisan, the doctor, the lawyer, the merchant, the literary worker, and many others; and they leave the schools for all kinds of life work. They differ in tastes, in talent, and in the life work which they will later do. The instruction given them must be cut on many patterns. A single type of education no longer meets the needs of society. "Every important form of industrial and commercial activity, as well as every phase of institutional and professional life, demands its technically trained leaders, so that we must have schools, not only for statesmen, lawyers, doctors, and divines, but for engineers, architects, chemists, merchants, industrial workers of every grade, and even for foresters and agriculturists. Many of these phases belong to University training, but all of them have their roots in the high school." [1]

[1] De Garmo, C., "Principles of Secondary Education; the Studies," p. 13.

School men everywhere now recognize the necessity for a reconstruction of the work of our public school system to meet the demands of new times and new ways. The unsatisfactory results, under present conditions, of the old exclusively literary curricula are evident. It is necessary to bring school work into closer relations with the real life and activities of the masses of our people. That the unprecedented industrial development of the past century must be taken into account in the education of our young people is strongly felt.[1]

Though we still strive, as in past years, for culture and mental discipline as results of education, yet we recognize that education is not for these alone. The physical, the economic, the social, the intellectual, and the spiritual should all have opportunity for development; and the studies of our schools should contribute towards that development. Though intellectual training must always continue to be the dominant feature of all educational work, yet we have come to realize that education must, in addition, give efficiency, if it is to accomplish its purpose in our modern world.

Moreover, any one who is thoroughly informed as to recent investigations in educational psychology knows

[1] Davenport, E., "Industrial Education a Phase of the Problem of Universal Education." National Education Association, Proceedings, 1909, p. 279. "No scheme of education is truly universal or can hope to become so until it not only touches and uplifts all classes of men but also touches and uplifts their industries as well."

that the old idea that certain subjects, seriously pursued, result in the training of particular faculties, such as accuracy in observation, memory, etc., which can be employed in any field, whether related to that study or not, is false. We now know that though training in mathematics, or foreign languages, and similar liberal studies, results in the development of certain intellectual powers, yet these powers are not as readily applied to vocational pursuits that may be undertaken as was supposed. Indeed, it is asserted that training in one field means no training at all in other fields. Attempts to make the subjects of liberal education yield vocational efficiency must fail because of the very nature and purpose of these subjects. To attempt to make them vocational deprives them of significance as factors in a liberal education without giving any real vocational efficiency.

The objects of modern democratic education — efficiency with mental training and culture, for many different classes of people — can only be attained by an enrichment of the curriculum and the addition of vocational subjects. A few studies will not accomplish the results desired for our many pupils. A variety of studies is necessary. There must be opportunity for mental training along many lines, that each may get for himself that knowledge and those appreciations, that training in habits and methods of work, which will be of the greatest service to himself.

In the enrichment and improvement of our public school work the vocational studies are clearly the most effective means to be employed, for such studies not only give practical training for work and life but they realize the aims of a liberal education.[1] They are thus given an advantage over the liberal studies, which, though important as factors in liberal education, do not contribute to vocational training or efficiency. The vocational subjects vitalize and add interest to the ordinary work of the school, connect the school work directly with life and the

[1] Lange, A. F., "Self-directed High School Development." University of California Chronicle, vol. XII, No. 4, p. 9. "The cultural mission (of education) can no longer be fulfilled through the so-called culture studies alone. Little by little we shall doubtless learn to teach mathematics and the sciences, history and civics, literature and the languages, so as to start from actual life for knowing and to come back to it for doing; but even then we cannot wisely leave out the subjects that specifically epitomize the economic activities of our contemporary civilization and lead over to the material side of the world's work. What life has ceased to give, the school must supply and improve on. Quite apart from vocational issues, efficient citizenship, the very heart of liberal culture from the viewpoint of democracy, demands, now-a-days, a trinity of developed senses, — a vivid historic sense, the scientific evolutional sense, and a practical economic sense. It implies that neither those who can and will prolong their school career nor those who must cut them short should be deprived of the chance to get and keep in active, intelligent, sympathetic touch with the work and workers of our farms, our industries, our commerce. Accordingly, no high school is fully adequate to its cultural purposes until it has a department of agriculture, or of commerce, or of the mechanical and domestic arts, . . . a department in charge of teachers every whit as broadly and thoroughly trained and as civilized as those of other departments, — ought to be."

industries of the world, and make the students who go out from the schools more efficient workers. They give information and mental training; and they also give ability to do certain definite things.

The value of these vocational studies was perhaps naturally first recognized in the highly organized systems of the cities, where the rapid increase in the extent and variety of the mechanic arts and manufactures created a tremendous demand for young people prepared to deal with the problems presented in such pursuits. The teaching of manual and mechanic arts was provided for and was soon amply justified. From the city schools the movement spread to towns and villages and the scope of the industrial work given gradually broadened.

The study of agriculture and domestic science, both fundamental occupations, though introduced somewhat later than the manual training work, have proved their right to a permanent place in our public school system. Their economic value was evident from the first. Their cultural and disciplinary value has been demonstrated.

Agricultural instruction is, like that in other vocational subjects, not only a means of adjusting our public school education to the society in which we live, but of adjusting the education to the individual to be educated. Certain phases of agricultural study are particularly well adapted to the adolescent period of development, through which high school boys and girls are passing.

The mental characteristics and attitude at this time are successfully appealed to and stimulated by the agricultural work.

Agricultural work in the high school takes into account both the sensory and motor powers of the individual, and appeals to and assists in educating each. It provides for both impression and expression, for gaining knowledge and for application of knowledge. Though rich in educational material for those students who are mentally strongest on the sensory-intellectual side, it provides particularly well for those who are strongest on the intellectual-motor side.

Agriculture is not only a vocational or industrial course. It is a scientific course. To understand and practice agriculture properly, the elementary principles of all the high school sciences must be understood. By agriculture these are vitalized and their application to real life made evident.

Nor is agriculture merely vocational and scientific. It is also cultural.[1] It teaches how to think, how to do,

[1] Eliot, C. W., "A New Definition of the Cultured Man." National Education Association, Proceedings, 1903, p. 54. "Let us as teachers accept no single element or kind of culture as the one essential; let us remember that the best fruits of real culture are an open mind, broad sympathies, and respect for all the diverse achievements of the human intellect at whatever stage of development they may actually be, — the stage of fresh discovery, or bold exploration, or complete conquest. Let us remember that the moral elements of the new education are individual choice of study and career among a great, new variety of studies and

and gives a broad view of life.[1] If properly taught, such work, perhaps better than any other one subject, makes possible the attaining of all the objects of school instruction — of education — as defined by former President Eliot of Harvard. It teaches how to "see straight and clear; to compare and infer; to make an accurate record; to remember; to express thought with precision; and to hold fast on lofty ideals."

The agricultural course in the high school prepares those students who cannot go beyond the secondary schools, and who are interested in agriculture, for a definite life work worthy of the best efforts of any intellect. It prepares the student who wishes to become an agricultural expert for the college, where he can complete his education. For the student in other courses, agricultural instruction, besides the mental training which it affords, vitalizes the regular science work, gives some

careers, early responsibility accompanying this freedom of choice, love of truth now that truth may be directly sought through rational inquiry, and an omnipotent sense of social obligation. Those moral elements are so strong that the new forms of culture are likely to prove themselves quite as productive of morality, high-mindedness, and idealism as the old."

[1] De Garmo, C., "Principles of Secondary Education; Processes of Instruction," Preface, p. vi. "All teaching is cultural in proportion to the extent and quality of the insight it enables the student to attain. All instruction, likewise, is disciplinary to the extent that it renders the student efficient in the use of what he has learned. Culture and discipline are accordingly the inevitable concomitants of all good instruction and they become in turn the just measure of its effectiveness."

understanding and appreciation of a fundamental industry and our universal dependence on it, and dignifies an indispensable occupation.

The inclusion of agriculture and other vocational work in the high school curriculum gives to students a view of the kind of work typical of various occupations and thus assists them in selecting a life work.[1] "Not every boy born in the city should always remain there; nor should every boy born on the farm be a farmer. The teaching of agriculture and the manual arts in the public schools will afford an opportunity for selection, and the boy from the city with rural tastes will, through this special course in instruction, secure new information and a proper attitude towards the farm. The boy from the farm will have an opportunity to secure information and a new ideal of farm life, but if some other vocation appeals to him more strongly, the work of the high school will discover it."[2]

[1] Hyatt, E., "The Opportunity of the California High School," 1910, Bul. California State Superintendent of Public Instruction, p. 3. "Is it the part of wisdom to exclude our chiefest industry from the high school, where our choicest young people are preparing for life? The thing is absurd; preposterous. The genius of agriculture should overshadow, dominate our rural high schools. Our high schools everywhere should be in sympathy with the industrial life of the people who surround them and should intelligently undertake to broaden and enrich that life to make it more efficient, better able to meet competition. In that way only can the high school in future have a right to live and grow."

[2] Michigan Agricultural College, Department of Agricultural Education. "Course in Agriculture for the High Schools of Michigan," p. 5.

Lastly, we may give as an argument for agricultural education in the secondary schools the fact that in whatever country such instruction has been introduced (notably France and Belgium), it has materially raised the age of leaving school, — from two to three years. What statistics we have so far been able to accumulate in the United States go to prove that the same thing is true in this country where agriculture has been put into the schools. This alone should prove a valid reason for its inclusion in the curriculum, and when considered in connection with its proved educational value, should insure it a universal and permanent place in our public school work.

PRACTICUM

List at least five instances in which it can be clearly proved that agricultural information, secured through study or experiment at our educational institutions, has materially increased the products and profits of a locality or state.

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CHAPTER III

THE PLACE OF AGRICULTURE IN THE HIGH SCHOOL CURRICULUM

Observation and investigation show clearly that modern industrial and social conditions demand a new kind of education, in which the instruction given in our public schools shall cover a wide range of studies and include many subjects, some of which at least are intimately connected with basic industries and the real life and activities of the masses of our people.

It is obvious, however, that in our public high schools it is necessary for many reasons to limit the number of subjects to be taught and to select from each only special portions for study. We must, therefore, select from the many possible subjects those which seem best suited for high school study, and we must decide as to what portion of each subject shall be pursued, when it shall be begun, in what order taken up, and how long studied. That is, we must arrange a high school curriculum.

In making up this curriculum as a whole we must remember that all studies naturally group themselves in three classes: the natural sciences, or those that per-

tain solely to nature; the humanities, or those that pertain primarily to things purely human, such as history and languages; and the economic sciences, or those in which "the laws of nature are applied by human volition to produce the conditions for the well-being of individuals, the multiplication of populations, and the further development both of natural sciences and all that pertains to man as such."[1] No one of these groups may be overlooked. Courses representative of each should be included in the curriculum. In the small high school it may be necessary to confine the curriculum to a very few of what seem to be, for secondary students, the more important representatives of each type. In the high school with a large corps of teachers, there may be very many studies representative of each great type of studies.

That no one student is able profitably to pursue all the many lines of study of the modern high school is evident, since this is prevented by lack of time. Moreover, it is inadvisable, even if it were possible, for him to pursue every individual study throughout his entire high school course.

It therefore becomes necessary to arrange the subjects of the curriculum into courses of study, each of which is fitted to the needs of a special class of students; as, those

[1] De Garmo, C., "Principles of Secondary Education; the Studies," p. 46.

who are preparing for certain definite courses in college, those who expect to leave the high school for vocations, those who are particularly adapted to benefit by certain lines of work, etc. However, in making up the special courses of study, as in the making of the curriculum, representatives of all the great groups of study should be included. In each of the special courses of study must be included a maximum of those subjects which will be particulary useful to the student in his further education or in his life work, but at the same time opportunity must be given for the acquirement of an education that is in no way limited to the demands of his special vocation or special interest. Some of the work of each course must be prescribed, for the school authorities naturally know far better than the immature student what subjects are absolutely necessary in a rational, progressive, well-balanced course along the chosen line. To suit individual differences in taste, ability, and personal need, there must also be opportunity for many elective studies. No important field of knowledge or of essential training can be overlooked or ignored. At the same time, opportunity must be given for individual choice within the selected course.

The organization of the classical, modern-language, scientific, and certain other high school courses has been well worked out; and these are fairly fixed, though flexible in nature. But the organization of the high

school agricultural course, though it has for some years been a matter of much discussion, is very unsettled. There is as yet no harmony of opinion as to just what shall be taught, or when. The agricultural materials to be used and the teaching methods to be employed are undetermined. Few definite principles of procedure in the organization and teaching of agriculture in the high school have been enunciated; and practically none have been established. In short, while educators are agreed as to the necessity and value of agricultural instruction in the secondary schools of communities where agricultural interests are prominent, they are not agreed as to the organization of the work or the methods by which it shall be taught; and comparatively few pedagogically sound ideas have been put forth on either point.

The reasons for this chaotic condition are numerous. As yet the differentiation between the agricultural work of the upper grammar grades and the early years of the high school is very imperfectly worked out. The secondary schools are in many cases obliged to give work which might well be given in the elementary schools. The colleges and universities are still giving courses which will probably later be conceded to belong only in the secondary schools. This makes the laying down of any rules as to the work to be given in the high school very difficult. Doubtless this differentiation will eventually

be worked out by the normal schools and colleges teaching elementary and high school methods in agriculture, but at present very little has been done.

The function of agriculture and the other sciences in the high school and their relation to each other are not as yet perfectly clear. We must have a better understanding of this before we can organize the high school agricultural course to the best advantage. It is argued by some that agriculture must be introduced in the high school as one means of vitalizing the sciences, but that it should be taught in connection with the sciences and not as a separate course, except possibly in the last year of the high school, when a synthetic course may well be given. By others it is urged that the sciences should change their viewpoint and be taught from the viewpoint of agriculture, domestic science, and other industrial occupations, not only for the vitalizing of the science work, but in order that the special courses in agriculture, domestic science, etc., may thus be permitted to put more time on the technical phases of their subject matter. Still others hold that while courses in agriculture may well be included in the high school, their chief function is to serve as a vehicle for scientific facts and as a means of relating the various sciences one to the other, not to prepare students to do definite agricultural work.

However, the majority of teachers feel that though

agriculture depends upon the various sciences, and the successful agricultural student must learn and apply various botanical, chemical, physical, and physiological facts and principles, yet both agriculture and the various sciences should be taught from their own standpoints. Though granting that in the teaching of the sciences many agricultural applications may well be noted and made use of, and though realizing that in agricultural teaching the scientific principles underlying the art must be made plain, they feel that agriculture should be taught as agriculture, chemistry as chemistry, and botany as botany. They say that there is no more reason for incorporating agriculture with the other sciences in the high school than there is for incorporating domestic science with them; that agriculture should be taught as a separate course just as domestic science, manual training, and other industrial work is taught separately. Moreover, though agriculture is an industrial course it is also a scientific course; and there is no more reason for correlating agriculture with the other sciences at the expense of a separate place in the curriculum than there is of so treating physical geography, or botany, or physiology. All three of these draw on the other sciences very largely, yet their right to a separate place in the curriculum is not even challenged. Then, too, not only does agriculture cease to be presented in the most profitable way for high school stu-

dents when given only in connection with the other sciences, but if chemistry is limited to agricultural chemistry, physics to agricultural physics, botany to agricultural botany, and so on, these sciences themselves suffer. They are to some extent vitalized by the agricultural applications, to be sure, but they are limited in effectiveness by the definiteness of their scope. Many of the high school pupils will not take up agricultural work, but will go from high school into other industries. It is not fair to them that they should, in the few years of their schooling, be limited in their pursuit of science studies by having the work of those studies largely controlled by the applications of a single industry.

All these suggested questions, and many others, as to the function of agriculture and the sciences in the high school, their relation to each other, and the extent to which coöperation between them is profitable and advisable, must be debated and more or less definite conclusions reached before we can have a systematic, satisfactory high school agricultural course, the general outlines of which are universally accepted.

Moreover, we have the special technical agricultural high schools and the regular high schools giving agricultural courses. For both of these, at present, there seems to be a field. But it is evident that the courses must differ considerably in the two classes of schools. The local high schools cannot try to do as pretentious

work as the special schools because of the excessive cost of an extensive equipment. The selection of courses for any local public high school will necessarily, for many years at least, be more or less influenced by the means available for equipping and maintaining the work.

Then, too, conditions differ in different states and localities. Agricultural instruction in the secondary schools, to be of the greatest value, must be definitely adapted to the community. A fixed course and fixed materials for instruction will fit very few places. Materials for instruction must be selected from the vast wealth provided by the science and art of agriculture with regard to the needs of local pupils and of the community.

In spite of this unsettled condition of opinion as to the character of the agricultural work to be given in the high school, there are certain definite points which must be considered in planning the agricultural work in any high school where it is given as a separate course.

We must decide on the studies to be chosen for the course, remembering that besides agricultural subjects (representing the economic sciences), we must have in the course representatives of each of the other distinctive types or groups of studies, — the natural sciences and the humanities. This is true not only because certain of these studies are needed for the better understanding of agriculture, but because such a course seems

to furnish the material best suited to the all-round development of the individual. The degree and kind of representation must necessarily be governed partly by the size and qualifications of the teaching corps and partly by the general character of the agricultural course.

We must decide upon the number of recitation and laboratory periods per week that can reasonably be required of each student, being guided in our decision by the experience of other schools.

We must determine the amount of time which shall be given to each study chosen, deciding the terms or years during which it shall be taught and the number and length of the class periods per week. The agricultural work will naturally run throughout the entire four years, in one form or another. The work in other subjects will be given less time, though sufficient for a complete mastery of the portions of the subject chosen for instruction.

Having decided upon the subjects which shall be taught in the course and the amount of time to be given to them, we must next determine as to the content of the subjects chosen, — that is, as to the materials for instruction in each course. In this, as in the other problems noted, cumulative experience is the best guide. We must turn for help to such published reports as those of the National Education Association, of state boards of education, and of the agricultural education

experts of the United States Department of Agriculture. Many of these are national in scope and of great value. But in organizing the agricultural work of any school we must also turn to the experience of schools located in districts closely resembling the one we plan to serve. For in choosing the branches of agricultural instruction to be presented in any given high school and in determining the materials to be used, we must take into account the agricultural conditions of the district. We must teach the same basic principles of agriculture in all schools, but our selection of materials and emphasis of topics in presentation must be modified by local conditions and interests.

For example, if our high school is located in a district where live stock raising is impracticable, our courses in that subject will be very much more limited than if our high school is in a stock raising locality. If the paramount interests of the community are in horticulture, and practically no grain is raised, it would not be wise to devote time to the study of even such an admirable book as Hunt's "Cereals in America." In such a place the time devoted to the study of grains must be limited.

Some of the work of the agricultural course of the modern high school will be prescribed and some elective. Those studies dealing with the fundamental and elementary principles of plant and animal production and farm management must evidently be prescribed. But

those branches dealing with special phases of the industry, as poultry work, bee-keeping, etc., may very well be elective. In the choosing of subjects from the humanities and the natural sciences there should also be both electives and prescribed work. The essentials, as indicated by experience, must be prescribed. Other work may well be elective and selected by individual students according to personal taste and ability.

We must, in deciding all these questions, keep in mind not only the present and future needs of the student, the knowledge necessary for complete living and for vocational efficiency, but also certain psychological factors.[1] In our selection of studies and materials and in their order of presentation we must bear in mind the characteristics of the individual during this adolescent period of development. We should take into account the apperceptive basis which the student has for the work, that is, his previously acquired ideas and experiences; his previously acquired habits, in accordance with which he adjusts himself to his environment; and the economic sanction, by which an appeal is made to the pupil's desire for production and ownership and by means of which his serviceableness to the race may be increased.

In addition, in certain districts the sequence of studies

[1] Bricker, G. A., "The Teaching of Agriculture in the High School," pp. 56–90.

must be affected more or less by the seasons. This is not true in parts of the South and on the Pacific Coast, however. There, almost any necessary materials for agricultural study can be secured at any time of year. The work is not hampered and hindered by seasonal conditions as in the East, and it is not necessary that these determine the sequence of agricultural studies.

In planning the four years' agricultural work of the high school it is evident that the study of the plant furnishes probably the best first year or beginning course. All agricultural occupations are based on plant production. Moreover, many plants are familiar to children and by their use in instruction advantage may be taken of the psychological factor of apperception. Then, too, the economic sanction is strong in this as in much of the other agricultural work.

In presenting the work there are good psychological reasons for beginning with the study of plant products and following this with study of the plants producing them. If no agricultural work has been given in the elementary school, this order of presentation may be necessary. But it is far preferable that the elementary study of plant products, and of certain animal products as well, should be taken up in the elementary schools, and the agricultural work of the high school begin with a study of plant growth and development.

From this elementary introductory work there natu-

rally opens up a somewhat detailed study of environmental conditions, — temperature, light, heat, moisture, soils, fertilizers, etc., followed by special study of important crop plants of the locality. A study of farm animals, the utilizers of plant products, and of animal products and their utilization, as in dairying, comes next. Farm machinery (needed in the production and care of plants and animals and their products), and its use, should then be studied; while last in order should come the consideration of all the things that go to make up the farm work and life in their relation to each other, — that is, farm management and farm economics.

We thus proceed, in accordance with pedagogical principles, from the more familiar to the less familiar, from the known to the unknown; and from the concrete and definite to the more abstract principles of agricultural practice.

Though the courses given and the amount of time allotted to each may vary widely to suit different conditions, the sequence of studies should be, in general, as outlined. During the first high school year there should be an orderly and progressive study of the elements of plant production and some special study of local crops. Animal production, usually given under the names of animal husbandry or zoötechny, may follow in the second year, or, if horticultural interests are paramount, horticulture may follow the introductory course in plant

production. If dairying is an industry of sufficient importance in the community, a course in this subject may well be given during one semester of the year in which animal husbandry is given. In any event, some time should be given to the study and testing of dairy products. If no dairy course is given, this may be inserted in the animal husbandry course. If horticulture is of relatively little importance in the locality and live stock raising is preëminent, a special course in poultry culture or some special live stock topic may well be given a half of the year which would otherwise be assigned to horticulture. In the last high school year, as mentioned before, should come an elementary study of the more important topics dealing with agricultural machinery, rural engineering, rural economics, and general farm management.

Rural engineering in many of its aspects is too technical for students in secondary schools; but some time should be given to the study of ordinary farm machinery, to planning the outlay of farms, farm buildings, water and sewage disposal systems, etc. Many rural economic topics are unsuitable for study in secondary schools. But some of the more important social and economic problems of rural life should certainly be presented for discussion, and the general principles of marketing, farm accounts, etc., should be studied.

In time we shall doubtless have as helps in the or-

ganization of the high school agricultural course many carefully formulated outlines of courses as adapted to special states and localities. In the meantime we must use the best at present available to help us in outlining others. Several of these are appended, showing the practice in different localities where agriculture has been successfully taught, or giving examples of courses worked out in support of special theories as to secondary agricultural education.

A

Syllabus of a four-year secondary course in agriculture prepared by A. C. True of the United States Department of Agriculture. (Office of Experiment Stations Cir. 91, pp. 10–11.)

REQUIRED SUBJECTS

Subjects	Units[1]	Hours per Week				Total Hours[2]
		1st Year	2d Year	3d Year	4th Year	
English . . .	3	5	5	3	2	540
Algebra . . .	1	5				180
Geometry . .	1		5			180
History . . .	1			2	3	180
Botany . . .	1	5				180
Chemistry .	1		5			180
French or German . . .	2			5	5	360
Agriculture .	4	5	5	5	5	720
Elective . .	2			5	5	360
Total . .						2880

[1] A unit consists of 180 hours, *i.e.* 5 hours per week for 36 weeks.

[2] Recitation periods of 45 minutes are designated as "hours." In laboratory practice, demonstrations, bookkeeping, surveying, and agricultural practice an hour is a double period or 90 minutes.

Elective Subjects

Subjects	Units	Hours per Week		Total Hours
Drawing	$\frac{1}{5}$	1 hour	1 year	36
Bookkeeping	$\frac{1}{5}$	1 hour	1 year	36
Civics	$\frac{2}{5}$	2 hours	1 year	72
Solid geometry	$\frac{1}{2}$	5 hours	$\frac{1}{2}$ year	90
Plane trigonometry and surveying	$\frac{4}{5}$	2 hours	2 years	144
French or German	1	5 hours	1 year	180
Botany, chemistry, or physics	1	5 hours	1 year	180
Agriculture, horticulture, or elementary forestry.[1] . .		1 to 5 hours 3d and 4th year		

Required Subjects for All Students in Agriculture

Subjects	Units	Hours per Week				Total Hours
		1st Year	2d Year	3d Year	4th Year	
The plant and its environment	$\frac{2}{5}$	2				72
Farm crops	$\frac{1}{5}$	1				36
Agricultural engineering	$\frac{2}{5}$	1		1		72
Horticulture and forestry	$\frac{1}{5}$	1				36
Economic entomology .	$\frac{2}{5}$		2			72
Animal husbandry . .	$\frac{2}{5}$		2			72
Dairying	$\frac{1}{5}$		1			36
Diseases of plants and animals	$\frac{2}{5}$			2		72
Farm management . .	$\frac{2}{5}$				2	72
Subjects to be added from subjoined list A .	1			2	3	180
Total						720

[1] These are in addition to the 720 hours of required subjects in agriculture and are offered to permit specialization in some branch of agriculture by students not intending to take a college course in agriculture.

List A. — Subjects from which Selection must be made to make up the Required 720 Hours in Agriculture

Subjects	Hours per Week		Total Hours
	3d Year	4th Year	
Farm crops	2	2	72 or 144
Animal husbandry	2	2	72 or 144
Dairying	2	2	72 or 144
Horticulture	2		72
Forestry	2		72
Agricultural engineering		2	72
Rural economics	1	1	36 or 72
Plant breeding	1	2	36 or 108

B

University of Wisconsin recommended high school course in agriculture.

(University of Wisconsin Bul. No. 441, High School Series No. 12, pp. 8–9.)

General outline of agricultural units.[1]

Farm mechanics.

One-half unit in freshman year.

Farm management.

One-half unit in freshman or senior year.

Plant husbandry.

One unit in sophomore year.

Animal husbandry.

One unit in junior year.

Agricultural chemistry and soils.

One unit in senior year.

General outline of basic sciences.

Botany.

One-half year in freshman year.

[1] One unit represents daily exercises throughout the school year.

Physiology.

One-half year in sophomore year.

Chemistry.

One-half year in freshman year or one year in junior year.

Physics.

One year in senior year.

NOTE. — To this may be added: physical geograpny, one-half year in the freshman or the sophomore year.

Suggested arrangement of work in agriculture and related sciences.

First year

Farm mechanics	Botany

Beginners' chemistry where no other chemistry is taught.

Electives to make up the required number of units.

Second year

Physical geography	Physiology
Plant husbandry	Plant husbandry

Electives to make up the required number of units.

Third year

Animal husbandry	Animal husbandry
Chemistry	Agricultural chemistry

Electives to make up the required number of units.

Fourth year

Soils	Farm management
Physics	Physics

Electives to make up the required number of units.

C

High school course in agriculture.
(Michigan Agricultural College, Agricultural Education Department Bul. 1, pp. 12–13.)

The following course includes three units which practically conform to the State High School Course of Study. The high

school work is purely suggestive, as it may or may not conform to the regular course of study pursued in the school. It is given here to show the relation and general arrangement.

The course in agriculture is elective and covers one unit in each grade of the high school giving a four-year course, and the unit in each case is made up of a combination of two or more subjects which are to be pursued during the year. This arrangement makes it possible for regular students to elect agriculture, and for a student who has already been graduated from the high school, or who enters for the purpose of taking the agricultural work only, to complete the entire course in one year. The purpose of this course is both educational and practical. It gives an opportunity for the practical application of the laws and theories of other sciences taught in the high school, also a working knowledge of the agricultural subjects themselves. This phase should be constantly kept in mind by the teacher.

COURSE

9TH GRADE	10TH GRADE	11TH GRADE	12TH GRADE
English	English	Literature and composition	Literature and rhetoric
Algebra	Geometry	Physics	Chemistry
Arithmetic and bookkeeping	General history	Commercial geography	American history and civics
		Zoölogy	
Botany	Crops el. Soils and tillage } ½	Live stock, types and breeds Dairying } ½	Live stock, improvement, feeds and feeding } ½
Agricultural botany	Horticulture Entomology } ½	Soils and soil physics } ½	Poultry Farm management Farm mechanics Farm machinery } ½

NOTE 1.—Permit students to take all the agriculture possible. Induce young men to enter school just for agriculture and take the course in one year.

NOTE 2.—This course may be varied to meet local conditions. Live stock, horticulture, or soils may be emphasized according to the character of farming.

In the subject of agriculture there should be at least daily recitations for three periods each week, the other days being used for laboratory work and for study and observation on the experimental plots or on the farms. The number of recitations, however, must be determined by the conditions of the school, number of students, and number of classes. It is probable that the greatest value will be derived from laboratory practice and from actual study and observation of surrounding farms, therefore ample time should be given to it. It may be necessary to give more than three recitations and less laboratory time.

D

New York State Education Department suggested Agricultural course for high schools.

(N. Y. State Education Department Bul. 492, "Schools of Agriculture, Mechanic Arts, and Home Making," p. 17.)

	CREDITS
First year	
English	4
Algebra	5
Biology	5
Mechanical drawing	3
Carpentry and joinery (Laboratory periods)	2
Total	19
Second year	
English	3
Plane geometry	5
Physics (agricultural)	2½
Agriculture (elective — "home project" work, or elementary general agriculture)	3
Agriculture, cereal and forage crops, first term	2½
Agriculture, poultry raising, second term	2½
Total	18½

	Credits
Third year	
English	3
Elementary bookkeeping	3
Chemistry (agricultural)	2½
Economics	2
History	3
Agriculture, animal husbandry, first term	2½
Agriculture, potato growing, second term	2½
Total	18½

Fourth year	
English or commercial English and correspondence	3
American history, with civics	5
Agriculture, general fruit growing, including apples	5
Agriculture, dairying	5
Total	18

Two and one-half credits are given for the equivalent of 5 recitation periods of 45 minutes each of prepared work in agriculture throughout a half year. Each laboratory period of 90 minutes on unprepared work counts as one recitation period. Two laboratory periods per week alternating with three recitation periods are recommended for the agricultural courses. Thirty credits for special agricultural work are required in the course in vocational agriculture.

E

Maine agricultural course for high schools.
(Course in agriculture for high schools and academies in Maine, prepared by W. D. Hurd, of the College of Agriculture of the University of Maine, under the direction of the State Superintendent of Schools, p. 4.)

First year	
English	3 hrs.
Algebra	5 hrs.
Chemistry	5 hrs.
Soils, plant life, fertilizers	3 hrs.
Practicums, two afternoon periods of	2 hrs. each
School gardening	

Second year

English	3 hrs.
Geometry	5 hrs.
History and civil government	5 hrs.
Live stock, dairying, poultry	3 hrs.
Practicums, two afternoon periods of	2 hrs. each
School gardening	

Third year

English	3 hrs.
Physics	5 hrs.
History	5 hrs.
Field crops, fruit growing, vegetable gardening	3 hrs.
Practicums, two afternoon periods of	2 hrs. each
School gardening	

Fourth year

English	3 hrs.
Reviews	5 hrs.
Commercial arithmetic, bookkeeping, etc.	3 hrs.
Agricultural engineering, farm mechanics, farm management, plant diseases, economic entomology	5 hrs.
School gardening	

NOTE.—The number of hours per week in the above course of study is not so large as to prevent the election of other studies in the high school courses.

F

Agricultural course of the Guthrie County High School, Panora, Iowa.
(Catalogue.)

Freshman year

Arithmetic, algebra, American history, civics, English grammar and composition, literature, Latin.

Sophomore year

First semester	Second semester
Algebra	Algebra
English	English
Ancient history	Mediæval and modern history

Animal husbandry	Animal husbandry
Feeds and feeding	Agronomy
	Bookkeeping

Junior year

First semester	Second semester
Plane geometry	Plane geometry
German	German
Physics	Physics
Geology	Geology
Farm mechanics	Farm mechanics

Senior year

First semester	Second semester
Solid geometry	German
German	English
Political economy	Chemistry
Soils	Soils
	Horticulture
	Advanced arithmetic

G

Kern county (Bakersfield, California) high school agricultural course.
(Catalogue.)

Freshman year
- English
- Algebra
- Elementary science
- Music or letter writing
- Drawing
- Shop

Sophomore year
- English
- Geometry
- Chemistry
- Arithmetic
- Music or letter writing
- Drawing
- Shop

Junior year
- English
- Advanced algebra
- Trigonometry
- Applied science
- Qual. analysis
- Agriculture

Senior year
- English
- U. S. history
- Quant. analysis
- Surveying
- Agriculture

Special one-year course in agriculture

- English
- Shop mathematics
- Shop drawing
- Agriculture and shop

The special course includes approximately 450 hours of work in drawing, carpentry, and blacksmithing, and 630 hours of agriculture, including botany, horticulture, animal husbandry, soils, and crops. One hour daily is given to each of the following: shop

mathematics and English, elementary chemistry (including soil analysis). This course is for pupils over 18 years of age.

H

Gardena (California) agricultural high school course in agriculture.
(Catalogue, and Gardena "Reporter.")

	Units or Credits
First year	
General science and gardening	5
English	5
Algebra or applied mathematics (practical arithmetic)	5
Carpentry and drawing	5
Music or oral English	2
Second year	
Agricultural botany	5
English or foreign language	5
Economic zoölogy. Animal industry. Economic entomology	5
Forge and mechanical drawing	5
Music or oral English	2
Third year	
Agricultural chemistry	5
Horticulture and forestry	5
Dairying and poultry	5
Elective (English, foreign language, mathematics, cabinet work)	5
Fourth year	
Agricultural physics	5
Soils and fertilizers. Farm crops and farm management	5
Rural law and economics	2
Bookkeeping and farm accounts	3
Landscape gardening and greenhouse management	3
Civics and history	5
Special problems	2

I

Holtville (California) union high school agricultural course.
(Catalogue.)

First year
- * English
- * Elementary algebra
- * Physical geography
- Manual training (either one-half or a full year)
- Freehand drawing (one-half year)

Second year
- * English
- * Applied botany
- Manual training (either one-half or a full year)
- Freehand drawing (one-half year)

Third year
- * Agriculture
- Chemistry
- Physiology
- Manual training
- English

Fourth year
- * Agriculture
- * Physics
- * United States history and civics
- English
- Manual training

* Those subjects starred are required; the rest are elective. Other electives are also allowed in penmanship, orchestra, singing, and athletics.

J

Coin (Iowa) high school course in agriculture.
(Office of Experiment Stations Annual Report, 1910, pp. 367–369.)

First Year

Farm crops. — Corn, seed corn, oats, wheat, potatoes, sweet potatoes, sorghum, sugar beets.

Legumes. — Alfalfa, red clover, white clover, alsike clover, mammoth clover, cowpeas, soy beans, and vetch.

Grasses. — Kentucky blue grass, timothy, redtop, and orchard grass.

Silos. — Historical, form and construction, cost, selection and culture of silage crops, filling the silo, composition and feeding value of silage.

Weeds. — Identification of the neighborhood weeds by means of seeds, stems, and leaves. Habits of growth and methods of eradication. State ways in which weeds are an injury to the farmer. Name not less than five of the worst weeds, and state why. Classify weeds as to habits of growth; also as to annuals, biennials, and perennials.

Collect seeds from all weeds, vegetables, fruits, nuts, and flowers in the neighborhood. Put them into envelopes or bottles and label each with date, name of plant, where found, and name of collector.

Problems on yield, on amount of the three principal food elements needed to replace that taken by different crops, on fencing fields of different sizes, on number of bushels of corn in different size cribs, or bins, etc.

Soil formation. — Mechanical agencies, the chemical action of air and water, plants and animals as soil formers and improvers, soil materials, light and heavy soils, physical characteristics of soils, moisture relations of soils, heat relation of soils, soil temperature affected by color and drainage, chemical characteristics of soils.

Experiments in the laboratory and on plats to determine the water-holding powers of different soils, experiments to demonstrate the capillary movements of water in soils under different

conditions, experiments to show the different methods of conserving soil moisture, experiments to determine whether compact soils will hold more water than loose soils, experiments to determine how organic matter in the soil affects its water-holding power.

Second Year

Horticulture. — The plant: propagation of plants — by means of seeds, by cuttings, by layering, by grafting, by budding, by bulbs, rootstalks, stolons, and corms.

Pruning of common fruit, shade, and ornamental trees of different ages; grafting of apple, peach, pear, etc.; budding peach seedlings. Note how fruits fertilize. The proper way to plant a tree and its subsequent care. Identification of neighborhood trees and shrubs. The most troublesome insect and fungus enemies of fruit and ornamental trees and their destruction by spraying and otherwise. Special work in making and the application of spraying mixtures.

The fruit garden, the vegetable garden, the school garden.

Study of roots, stems, and leaves. The preparation and use of hotbeds, coldframes, and pits.

Fruit growing. — The apple, peach, pear, strawberry, raspberry, blackberry, currant, and gooseberry. Define the terms seedlings, stock, scion, standards, dwarfs, freestone, etc.

Soil fertility. — Improvement by drainage, tillage, manures, fertilizers, lime, humus, green manuring, legumes, and rotation of crops.

Root tubercles and inoculation, sources of nitrogen, sources of phosphorus, sources of potassium, practical methods of maintaining fertility.

Testing soils for acid conditions, pot experiments in growth of plants by adding the different elements of plant food, also the same on field plats.

Comparisons made of crops grown on fields of different degrees of fertility, also comparative yields of the neighborhood.

Problems based upon the amount of plant food taken out of the soil each year by the different crops given. These problems should also show when to grow shallow or deep-rooted crops.

Third Year

Animal husbandry. — Cattle: beef breeds, dual-purpose breeds, and dairy breeds.

Milk. — Composition and characteristics, bacteria, how milk becomes impure and methods of prevention, use of the Babcock test, cream separators — care and management, management and delivery of cream, butter making, cheese making, renovated or process butter and how to distinguish same from genuine butter.

Testing of individual cows. — Study feeding practices of the neighborhood. Different cuts of meats — their location in the carcass and value for food.

Horses. — Breeds valuable for speed, draft horses, carriage and coach breeds, ponies, mules.

Sheep. — Short-wooled breeds, middle-wooled breeds, long-wooled breeds.

Swine. — Large breeds, middle breeds, small breeds.

Poultry. — General purpose breeds, meat or table breeds, egg breeds, ornamental breeds, turkeys, ducks, and geese, guinea fowl, squab raising.

Breeds and characteristics of farm animals to be carried through the year. Identification of breeds, judging market types of live stock, studies of local live stock interests, the elements of animal nutrition, — protein, carbohydrates, minerals, etc.

Feeding standards and balanced rations.

The common ailments of farm animals — symptoms and methods of prevention or treatment.

Fourth Year

The farm home, buildings, and surroundings. — Location of buildings, plan of house, cost and construction, modern conven-

iences. Barns and outbuildings, location, plans, cost, and construction, sanitary drainage and sewerage, disinfection, sources and supply of pure water. The lawn, walks, and drives. Selection and planting of flowers, shrubs, and trees. Cultural suggestions.

Equipment of houses and barns with heat, light, motor power, water pressure, ventilating and cleaning devices, and other machinery.

Farm mechanics. — Cement construction. Walks, basement, stable floors, and driveways, steps, tanks, small bridges, sewer pipe, drain tile, and reënforcement. Silo construction. Tools and leveling for drives. Location of tile and sewer drains. Construction.

Farm machinery. — A study of the elements of mechanics and of machine design entering into the construction of all machinery, followed by a special study of motors, including gasoline and steam engines, steam boilers, power transmission, windmills, water wheels, pumps, hydraulic rams, farm machinery for tillage, seeding, harvesting, etc.

Roads. — Macadam, sand-clay, burnt-clay. Methods and cost of construction, management, and care. Road drags.

Beekeeping. — Location, what race to choose, what hive to adopt, management in swarming, how to avoid stings, prevention of swarming, how to obtain surplus honey and wax, wintering, risk and loss through disease and enemies, beneficial effects in pollenization.

Forestry. — Forestry and farm designing. The need of forest planting, a planting plan, trees, and methods recommended. Special features about the farmstead. The life of a tree, the life of a forest, enemies of the forest.

Recitations on the history, production, and marketing of cereal crops, potatoes, field beans, forage, and miscellaneous crops.

Recitations on elementary farm accounting, selection and purchase of farms, cost and relative profit of various farm operations and systems of farming.

K

Agricultural course for high schools.
(Western State Normal School (Hays, Kansas) Bul. v, 2, No. 3, 1910, "Educational Agriculture," p. 25 and p. 33.)

Charts prepared by Josiah Main, of the Western State Normal, Hays, Kansas. Agriculture taught as applied science for the first three years of the high school; as a separate course in general agriculture the last year.

Chart I shows the relation of age, development, grade, and educational purpose, with agriculture projected below so as to show the corresponding development of the subject.

CHART I

Age . .	6 7	8 9 10 11 12	13 14	15 16 17 18
Grade .	I II Primary	III IV V VI VII Intermediate	VIII Grammar	IX X XI XII High school
Stage .	Transition	Formative	Adolescent	
Educational purpose	Environmental equilibrium	Experiences, facts, utilities, habits	Principles, system, science, ideals	

PHASE OF SUBJECT	NATURE STUDY, SCHOOL GARDEN, INCIDENTAL AGRICULTURE	LOCAL AGRICULTURE	ANALYTIC AGR. SCIENCE	SYNTHETIC AGR.
Genetic relation	Past	Present	Future-present	
Character	Cultural	Economic	Scientific-econon.	

CHART II

The high school course in science and agriculture. (Only the course as planned for the agricultural student is shown here, though much of it is in common with the regular science course.)

IX	X	XI	XII
The fundamental sciences taught with an economic application and by means of agricultural materials. Analytic and unorganized with regard to agriculture. Organized from the aspect of the fundamental sciences. Agriculture and science students in the same science classes.			The subject of agriculture organized as a science, — including materials treated analytically the previous three years. Vocational ideals inculcated. Science work continued independently.
APPLIED SCIENCE			GENERAL AGRICULTURE
Elementary Physics, Geography	Botany	Biology, Chemistry	
Soils Mechanics Tillage Weather	Economic plants Field crops Horticulture	Economic insects Diseases Fertility Foods and rations	Zoötechny Specialization, diversification, rotation Farm equipment Comparative agriculture Improvement by selection Rural economics

Formal and extra-program agriculture (vocational electives).

Farm animals, manual and technical arts, assumed services, home projects.

PRACTICUM

Outline a four-year course in agriculture adapted to the needs of a high school in any chosen town of your own State. Note size of town and approximate number of pupils in the high school. Give reasons for your

selection of each agricultural course and for the place chosen for it in the curriculum. Explain your choice of subjects other than agriculture to be included in the complete four-year course.

REFERENCES FOR COLLATERAL READING

BRICKER, G. A. Teaching of Agriculture in the High School. Chapter 7. N. Y. Macmillan. 1911.

ELLIS, A. C. Teaching of Agriculture in the Public Schools. University of Texas Bul. No. 85, Gen. Ser. No. 15. 1906.

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Organization of High School Courses of Study. National Education Association, Proceedings, 1911, pp. 1138–1152. Report of Committee on Courses of Study in Agriculture.

ROBISON, C. H. Agricultural Instruction in the Public High Schools of the United States. (See index under curriculum.) N. Y. Teachers College, Columbia University. 1911.

TRUE, A. C. Secondary Courses in Agriculture. Office of Experiment Stations Cir. 49. 1902.

CHAPTER IV

TEACHING METHODS TO BE EMPLOYED

The success of agriculture as a subject of study is naturally determined largely by the character of the teachers giving the work and by the methods employed. If agriculture is to be taught successfully in the high school it must be taught by one who has received special training in the science and art of agriculture, and in teaching methods. He must know his subject as thoroughly as the teacher of history or mathematics knows his; and he must know not only the facts but also the best means and methods of presenting them. He must, moreover, keep clearly in mind throughout the work that there are several aims to be striven for in his teaching, in addition to that of giving agricultural information. He must keep each of these aims in mind in giving the work. It should be his purpose to give not only knowledge but efficiency in its use; to awaken in pupils high ideals of country life and sympathy and appreciation for the animal, plant, and physical world which so largely makes up our environment. He must, in addition, more perhaps than any other high school teacher, give attention to the special needs of his school, its pupils,

and the community. He should have an intimate understanding of the agricultural interests and needs of the surrounding district and a genuine interest in all that tends toward the welfare and agricultural prosperity of its people.

Pupils taking the work of the agricultural course of the high school should acquire not only information, but the ability to apply the knowledge acquired. In addition, they should, at this formative period of their lives, acquire good habits with regard not only to farm life and work, but to natural phenomena wherever found. The high school agricultural work should give pupils information, the ability to do certain things, and practice in doing them. Not less important, it should leave with them right points of view as to agricultural facts, principles, and the occupation itself, and high ideals of accuracy, order, persistence, investigation, etc.[1]

That we may better understand the methods of securing these results from the agricultural work, we may well review briefly the ways in which knowledge and training are acquired by the high school pupil, ways which should be kept in mind by the teacher in presenting any subject of study.[2] We may then take up

[1] Bricker, G. A., "Teaching of Agriculture in the High School," pp. 133–138.

[2] De Garmo, C., "Principles of Secondary Education; Processes of Instruction."

these ways and means as they relate particularly to the agricultural work.

Outside of school a knowledge of facts is, as we know, acquired by first-hand observation and experiment or from authoritative sources through print or by word of mouth. Both methods are employed in the acquisition of knowledge in the school. The pupil gains information from the teacher by word of mouth in the classroom lecture, the discussion, etc.; from the printed page of his text and reference books; and through experiment or observation in the laboratory or elsewhere.

However, on account of the limited amount of time which the pupil spends in the school and the vast amount of knowledge to be acquired within a comparatively short period, there is a tendency for the major part of the knowledge gained to come at second hand, from the teacher or the textbook. Though this is necessary to a certain extent, it is desirable to increase, so far as is possible, the amount of knowledge acquired at first hand; for the acquisition of an undue proportion of knowledge of a subject "by authority" tends toward vagueness in and lack of understanding of the facts gained, accompanied by more or less indifference toward the subject itself. There should be, wherever possible, not only acquisition of knowledge by personal observation and tests, but verification of facts received by au-

thority in the same way. In this way there is not only greater certitude of the truth of the knowledge gained, but greater vividness in its impression upon the mind.

This last point is of especial importance in the case of the high school pupil, since he goes over such a multitude of facts in his studies during a comparatively short period. If the facts are not vividly impressed upon his mind, they are likely to be but imperfectly understood and temporarily retained. As a result, his interest in the entire subject of study to which they are related is lessened.

The teacher must provide, then, for the acquisition of knowledge by the pupil through authoritative sources and by personal observation. Having done this, he must teach the pupil *how to observe.* The high school pupil is immature and untrained and his observations apt to be very inaccurate and incomplete. He must be taught how to observe fully and accurately and must be led to see the relations of the thing observed to other things. There must be sense impression, followed by right inferences. Without both we cannot properly observe. An unbalanced admixture of inference with sense impression always results in poor observation. "If we infer too much, we think we perceive what is not true; if we infer too little, we are of those who, 'having eyes, see not.'"[1]

[1] De Garmo, C., "Principles of Secondary Education; the Processes of Instruction," p. 9.

Yet, though much useful knowledge can be acquired by the student by observation, there are many natural phenomena in which observation alone, even when aided by the use of scientific instruments, such as the microscope, dissecting tools, etc., does not enable him to discover facts and their relations. This is because the phenomena under observation are so complicated with others that the observer is unable to interpret them simply through his observations. Experiment therefore becomes necessary, — that is, the observation of the phenomena in question under varying and controlled conditions. Though the facts to be discovered by the high school pupil in his experiments are already known to his teacher and to many others, and are probably printed in many forms, yet it is desirable, and indeed necessary, that he should gain a knowledge of some facts in this way as well as by authority and observation. For he thus not only intensifies his knowledge, but also lays the foundation for scientific methods of investigation in his later school studies or life work. By his observations and experiments thought is stimulated, the desire to know is increased, and personal initiative is encouraged.

The high school pupil acquires knowledge of facts, then, by authority, by observation, and by experimentation. To what extent and in what way each means shall be employed in a given study depends, in the high school, upon the period of development of the pupil (the adoles-

cent), the nature of the study, the amount of time given to the subject, the amount of knowledge to be acquired during that time, the degree of efficiency desired in its use, and the equipment of the school.

But though the provision of suitable means for the acquisition of knowledge by the pupil is an important step in instruction, it is but a part of the work. The teacher must next lead pupils to an understanding of the facts acquired, through the processes of reasoning; and he must provide for the development of efficiency in the use of the knowledge gained, through practice in doing. He must give the pupil facts; he must teach him to think; and he must train him to do. Having selected materials for knowledge and provided means for their acquisition, the teacher must, by leading the student along the paths of induction and deduction, arouse and exercise and train his mind so that it shall serve him well not only in present but in future need. Yet he must not forget that to know and to think are not all of education or of life. The student must gain the ability to do. He must have practice in applying his knowledge; his information must be made to apply to concrete things, to solve definite problems. He must gain skill in using his knowledge under different circumstances and in many instances.

Having now reviewed the different ways in which knowledge and training are acquired by high school

pupils, we may next consider in some detail the use of these in agricultural instruction.

Through the agricultural textbook, the lecture, and the agricultural library the student gains knowledge from supposedly authoritative sources; on the field trip, in the laboratory, and on the school farm he gains much additional knowledge by observation and by experiment; and in the laboratory and through the field work of the school farm or through agricultural work at home, he is given practice in doing, resulting finally in skill.

Each of these factors in his acquisition of agricultural knowledge we shall discuss briefly, and, in addition, we shall make note of certain special agencies which have been found efficient as aids in high school work in agriculture.

To save time and effort, it is considered desirable in most high school courses to use a textbook as a basis for instruction. But there are few, if any, really satisfactory textbooks for high school agriculture in existence. What texts we have are nearly all general in nature, covering a one-year course treating of a vast number of farm topics. Such books include both too much and too little. Their authors seem to have made the effort to cover, in a single volume, the agriculture of the world, from cotton growing to landscape gardening. All the materials included are necessarily, therefore, treated in a very elementary way or insufficiently explained; and frequently a large part of the book deals

with crops and conditions of little or no interest in the particular community where agriculture is being taught in the high school. Others of these general agricultural books, advertised and used as high school texts, are really suitable only for the upper grades. Instead of helping gain the pupil's attention and interest they only too frequently prejudice him against agricultural work and give him the idea that it is not a subject worth study. Still others, though perhaps having certain merits as to the materials included, are carelessly written and poorly arranged.

There is little use in the high school for a general one-year agricultural course which treats of all farm subjects, — crops, animals, products, etc. Such a course is almost inevitably a mere hodge-podge of agricultural facts of more or less importance, giving but little valuable training or skill in the application of knowledge.[1] Therefore, we do not need or want, for the regular agricultural work of the high school, the kind of agricultural text-book which is universal in character, including all farm topics in one volume.[2] We do need well written, care-

[1] However, in a few schools where a general survey of agriculture as a fundamental industry is all that it seems advisable to give on account of the greater local importance of other industries, such a course may prove desirable, provided no college entrance credit is expected or given for it. But if the work is to be of any value it must be very carefully selected and limited.

[2] Such a book, with materials carefully selected and arranged, may, however, prove useful under the special circumstances mentioned under note 1.

fully arranged textbooks, adapted to the comprehension of high school pupils, on each of the subjects of a well-organized course in secondary agriculture, — as agronomy or beginning agriculture, dairy work, horticulture, etc. In each of these the fundamental facts and principles of the subject written about should be as scientifically treated and their explanation as clearly and logically expressed as is the case in the best secondary textbooks of the other sciences now commonly taught in the high school.

Unfortunately, there is at present, as has been said, a great dearth both of suitable texts and of laboratory manuals. There are, to be sure, one or two fairly satisfactory texts in dairying; but for high school horticulture, farm management, etc., there is nothing. As a result, teachers are sometimes found using as high school texts books totally unsuited to the work they are trying to do. Elementary botanies are used in place of a beginning agriculture or agronomy text. Textbooks suitable only for the use of college students are used in farm management and other special agricultural courses. Naturally, the results are almost inevitably unsatisfactory. Rather than use a poor text, the instructor should get along with none, utilizing the classroom lecture and reading references to agricultural books and bulletins in place of this means of acquiring knowledge.

And even though there may be a satisfactory text

which is used, the classroom talk or lecture and the agricultural library (see Chapter V) must be resorted to to supplement the text. For no high school agricultural text can be expected to contain the precise materials which will be advisable for all schools, wherever located.[1] Moreover, the good instructor will find it necessary to give frequent references to such books and bulletins of the agricultural library as deal with the topics taken up by the class, not only to supplement the work of the textbook, but to familiarize the pupil with the best in agricultural literature and to accustom him to using it.

The lecture should be utilized by the teacher to give to his pupils information on topics which seem insufficiently treated in the text, on additional topics which seem especially important locally, and to sum up or explain agricultural facts not given in any available book or bulletin in form suitable for the comprehension of his pupils. Logically arranged, clearly expressed classroom talks or lectures, illustrated whenever possible by objects, demonstrations, lantern pictures, etc., may be made a most fruitful and pleasant source of knowledge for the student, — summing up, explaining, emphasizing,

[1] This is true because of the nature of the subject. A carefully written elementary text in one of the pure sciences may be equally suited, exactly as it is, to almost all high schools. The agricultural text, treating largely of applied science, cannot be so universally satisfactory in the materials and practicums included.

and vivifying the work of the course, and inspiring the student with interest and enthusiasm.

Accompanying the textbook, lecture, and agricultural library work must come appropriate laboratory work, field trips or excursions, and practice work on the school farm or at home. Through these the principles or facts studied can be observed, tested, or put in practice.

In the laboratory, exercises may be performed by which the student discovers for himself some agricultural truth or verifies a statement read or heard. Or the pupil may observe demonstrations or experiments performed by the teacher before the class to teach definite principles. All of these should not only be closely and accurately observed by the pupil, but they should be carefully recorded. By this means not only are the things observed fixed firmly in mind, but, most important of all, the ability to observe completely and accurately is gradually formed. Moreover, in these records there is provided incentive and material for reflection on the relations of the things observed to other things, and by such records further observation is stimulated.

As has been said, we have as yet almost no laboratory manuals suited to high school agricultural work, and but few good exercises have been formulated and printed in textbooks or bulletins. This is not because there is a dearth of material, for the opposite is the case, but because little study has been given to the working out

of clear, concise, and logical series of practicums. These will doubtless come in time, as better textbooks will come. Indeed, the lack of good textbooks probably largely explains the lack of series of good laboratory exercises. For laboratory exercises are designed to accompany and explain and emphasize the various topics of a subject as taken up in a textbook or by the teacher in lectures. Where there is no text, and the outlining of each course is still largely a matter of individual option, the scarcity of logical series of practicums is natural. The task of providing them falls, then, to the individual teacher as he works out the special course to be given; and only too frequently lack of time and inadequacy of equipment are felt by him to be sufficient excuse for allowing this phase of his work to be very inferior. Every agricultural teacher should make a special effort to bring this feature of each of his courses up to the mark of its full usefulness. He should see to it that the agricultural laboratory is as completely equipped (according to its needs) as any other science laboratory; and he should secure from all available sources, or work out himself for his class, laboratory practicums to accompany and elucidate the work of the classroom.

But though the laboratory is a very important source of information for the pupil, the agricultural teacher should not forget that probably the most valuable illustrative material which he can use is to be found in the

community surrounding his school. He should use not only the school equipment in the way of books, apparatus, and grounds, but he should draw as much as is profitable from the surrounding community. Field trips or excursions should be made by classes to near-by farms to observe farm operations, to see and to study farm stock, and to observe the growing of crops under different conditions. There pupils may observe agricultural facts and see agricultural principles demonstrated. Through their observations they may be led to understand the reasons for success and failure in agricultural work. Good farmers may be asked to explain their operations to pupils; or they may be induced to bring animals to the school to be studied by the classes in agriculture when it is not convenient for the students to go to the farms. The towns or village barns and poultry yards, the butcher shops, livery stables, farm implement houses, and many other business places will also be found to furnish valuable illustrative material.

The teacher should familiarize himself with those resources of the community which can be profitably utilized by him in his teaching and should select from the wealth of material offered such as will be most helpful. Whenever possible he should see to it that the school work touches actual experience and conditions; and wherever possible he should make use of the experiences

and businesses of the community.[1] When a principle of agriculture is being studied that does not readily lend itself to illustration outside of the schoolroom, the laboratory must be utilized, with its specially prepared apparatus for experiments, demonstrations, etc. But the valuable illustrative material outside of the school should never be forgotten or neglected.

However, if the field trip is to be of any great value, it must be more carefully planned than is usually the case. The teacher must know definitely what he expects to show to his pupils and what he expects them to do, to observe, and to learn. He should know whether the conditions of the route gone over or place visited are such that a trip will really be of value. Proprietors of places to be visited should understand just when students are coming and the purpose of the trip; and no unwelcome visits should be made. Pupils should understand what they are expected to do and to observe before starting on a trip. Each student should be assigned a definite piece of work in collecting material, observing, etc., to be reported upon later. This work, though allotted sufficient time and opportunity for accomplishment, should leave the pupil little time to waste. He should be kept on the alert throughout the trip. Order should

[1] Crosby, D. J., "Use of Illustrative Material in Teaching Agriculture in Rural Schools." U. S. Department of Agriculture Yearbook, 1905, pp. 257–274.

prevail on the trip as in the classroom or laboratory. It is a different kind of order, to be sure, but it should be maintained.

Having provided for the acquisition of facts, we must next provide for their application. For this a greenhouse and experimental grounds or a school farm are necessary. Here the pupil puts into practice information gained, deals with actual problems at first hand, and achieves concrete results. In the greenhouse he himself propagates plants by the various methods of which he has read or which he has observed. In the school garden he works the soil, deals with the varying conditions which affect plant life, and learns personal lessons of failure and success. On the school farm he uses farm machinery, cares for live stock, prunes, sprays, and grafts trees, and puts in operation the thousand and one things which he has learned in the classroom, the laboratory, or by observation on field trips or elsewhere. Through repetition of this doing, that is, by practice, he not only acquires skill in the application of his knowledge, but learns many things which he would be apt to miss if only schoolroom work and field trips were provided for in the agricultural studies. By practice work is developed that self-confidence which is so important an element in success in any line; reason, foresight, and judgment are exercised; and enthusiasm for agricultural study is intensified.

Rules for field work must of course be sufficiently

fixed and definite, so that students will be held to good methods and thus acquire good habits of work; yet they should not be too fixed and definite. Students should be encouraged to discover new and improved ways of doing things; originality should not be crushed.

In addition to its usefulness in the ways mentioned, the school farm, through its experiments in the growth of newly introduced plants, in plant breeding, or in farm methods, may give the student an opportunity to take a part in valuable investigational work. He may thus be led to attempt original experiments and to acquire a permanent interest in such work.

But agricultural practice work may be carried on at home as well as at school. Pupils should be encouraged to attack individual problems in agricultural work and to carry them to a conclusion in home experiments. For not only is information and training thus acquired, but the power of taking the initiative is developed, self-reliance is cultivated, the value of labor is demonstrated, and the advantages of special knowledge are emphasized.

Lastly, we may well note some special aids which have been found helpful in increasing the efficiency of school work in agriculture. One of these is the organization of an agricultural club.[1] At the meetings of such a club,

[1] Howe, F. W., "Boys' and Girls' Agricultural Clubs," Farmers' Bul. 385.

which are usually freely open to all pupils and advertized in local papers, prominent farmers or others interested in agriculture are invited to speak; or the members take charge of the meeting themselves and give a more or less agricultural program. Contests may or may not form a part of the work of the club. In the Middle West, corn-growing clubs have been especially popular. These are associations of boys who enter a competition to determine which can grow the most or the best corn on a certain area of ground under definite rules of planting, cultivation, and exhibition of their product. Cotton-growing clubs undertake similar competitions in certain parts of the South. For girls these contests frequently take the form of joint contests with boys in gardening or poultry raising, though they may very profitably deal with various other problems.

Many such clubs are found in rural districts and many are organized in connection with the upper grades in town. In other cases they have no connection with the local schools, but are organized by officials of the extension department of the state agricultural college or by others interested. The agricultural club has also been profitably utilized as a part of the agricultural work and activities of the high school, and may well be made use of more widely.

In connection with the club work, exhibits of products raised by members may be shown at school exhibits,

county and local fairs, etc. Specimens of fruits, vegetables, and grains raised locally may be collected by members and preserved in glass jars as part of a permanent collection to be secured by the school for illustrative purposes. Weed seeds, specimens of injurious insects, etc., may be collected and put in properly labeled bottles or cases for the same purpose. Many other kinds of work may also be taken up, and social intercourse should not be neglected. The club will thus not only accomplish useful results, but it will bring persons interested in the same things into pleasant contact and intimacy, connect the school life closely with the home and social life of pupils, and serve as one means of making school patrons feel that something worth while is being done along agricultural lines in the school.

So far we have dealt only with agricultural instruction for the school pupils. In addition, the high school agricultural department may well undertake what is known as community work — that is, work with the community at large — with the men and women on the farms and the boys and girls who cannot attend school regularly. Though such work is not directly for the school pupils it reacts very favorably on the school work and increases its efficiency. It is therefore not out of place to consider it here.

This new work resembles the extension work carried on by the colleges, but differs from it in that the work

in the high school deals with people at first hand, while the college often treats them at the length of the state.

Some of the forms of community work now practiced in agricultural high schools or by agricultural departments in the regular high schools are, as outlined so admirably by D. J. Crosby and B. H. Crocheron in the 1910 Yearbook of the Department of Agriculture, those given below.[1]

1. Work with farmers, as winter lecture courses on agriculture, corn and potato shows, field and orchard demonstrations, home experiments, good seed distribution, seed and milk testing, preparing plans for buildings, and selecting and purchasing improved live stock and farm machinery.

2. Work with farm women, as afternoon or evening meetings and short courses at the school, house-to-house meetings, and home garden and poultry experiments.

3. Work with young people, as short courses in agriculture and home economics, literary societies, and nature-study clubs.

4. Work with rural school teachers, as meetings for agricultural instruction, nature-study rambles, attendance at school fairs and rallies, and outline lessons

[1] Crosby, D. J., and Crocheron, B. H., "Community Work in the Rural High School." U. S. Department of Agriculture Yearbook, 1910, pp. 187–188a.

in agriculture and home economics published in local educational journals.

5. Work with rural school children, as boys' agricultural clubs, girls' domestic science clubs, summer vacation encampments, rural improvement field days, and athletic field days.

All these forms of community work have been carried on by high schools in various parts of the country with great success. No one school will ordinarily be able to carry on all the lines of work, but each school can select those forms of community work which, it seems, will prove most helpful for the surrounding community. The agricultural high school may well undertake at least some one form of community work with each of the five classes of persons mentioned. In the ordinary high school in which the agricultural work is but one department, and there are only one or two agricultural instructors, it will probably be necessary to confine the work to one or two kinds of endeavor. The work to be done in any case and the special methods to be employed depend largely upon local conditions, such as the needs of the people, the size of the school, and the time available to instructors for such work. No definite rules can be laid down.

Such work adds to the work of the agricultural teacher, and it may be argued that it is unjust to burden him with it. But while it does take time and energy,

it will greatly help the teacher in gaining the interest and coöperation of the community in the actual school work. Frequently it results in definite and concrete help. Farmers make a special effort to coöperate with the school, to furnish illustrative material for the school work, and to assist in making field trips profitable for pupils.

It is also said that such work requires special ability and preparation. This has not proved to be the case, however. Any agricultural teacher who is really fitted to teach high school pupils is fitted to undertake some community work. The only agricultural teaching that is worth while is that which can stand the test of practice. If the teacher's schoolroom theories will not stand the scrutiny and test of the farmers of the community, he has no business to be teaching their children. If the agricultural information of the teacher is broad and thorough, he will find that farmers will be very responsive to his efforts to help them. The farmer of to-day is, in general, desirous of learning new and improved agricultural methods. The high school agricultural teacher is in a most admirable position to assist him. He is familiar with, local conditions and needs, and lives in the community to be served. It should be far easier for him to plan an interesting institute, short course, series of lectures, or home experiments, than for an outsider at the state capitol, the university, or elsewhere,

not so familiar with conditions, though the outsider may be a very able man.

PRACTICUM

Examine carefully ten agricultural textbooks intended for high school use. Write a brief critical estimate of each.

REFERENCES FOR COLLATERAL READING

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BUTTON, H. F. Short Courses and Extension Work in Agriculture for High Schools in the South. National Society for the Study of Education. Eleventh Yearbook. 1912. Part 2. pp. 75–82.

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CRANE, F. R. Short Courses and Extension Work in Agriculture for High Schools in the North. National Society for the Study of Education. Eleventh Yearbook. 1912. Part 2. pp. 83–90.

CROSBY, D. J. Use of Illustrative Material in Teaching Agriculture in Rural Schools. U. S. Department of Agriculture Yearbook. pp. 257–274. 1905.

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DAVIS, B. M. Agricultural Education. Chapters 12 and 14. Chic. University of Chicago Press. 1912.

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Arranged and compiled under the direction of the State Superintendent of Public Schools. Waterville. Sentinel Pub. Co. 1909.

Minnesota Department of Public Instruction Bul. 38. Outlines for Secondary Courses in Agriculture. 1912.

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CHAPTER V

EQUIPMENT

THE equipment needed for the teaching of agriculture in the high school will of course depend upon the size of the school and the amount and nature of the agricultural work to be given. It may be simple and comparatively inexpensive, or very extensive and costly, depending upon conditions and needs. But whatever the conditions, the equipment must be adequate if the teaching is to be effective. There has, in the past, been too much teaching of agriculture without sufficient equipment; and this has explained its failure or only partial success in certain cases. There has been too much said in commendation of going to the rubbish pile for old tin cans, bottles, paint pails, etc., and the use of makeshifts in carrying on the agricultural work of the high school. It should be remembered that it takes time and labor to get these things ready for use in the laboratory; they are only partially satisfactory when used; and, to say the least, they do not make an attractive laboratory. They may be made to serve in cases where it is the rubbish heap or nothing, to be sure, but their use should not be emphasized as it has been in the past.

Agriculture requires a definite special equipment as well as do the other sciences; and it should be provided. There is no more reason why agriculture should be taught "without funds and without equipment" than that chemistry be taught in that way. The necessity of adequate equipment for chemistry, physics, etc., is recognized. This should also be true with regard to agriculture. Yet even when the needs of adequate agricultural equipment are recognized, it is frequently said that the equipment for the pure sciences must come first; and after these are provided for there are usually no funds left for agriculture. Yet in only too many schools where this excuse is made, money has been really wasted on the equipment for the physical sciences; that is, the equipment has been injudiciously selected. Money has been spent not only for the necessary materials and apparatus, but for very expensive apparatus, probably used but once a year, perhaps less often, and sometimes for comparatively unimportant experiments. If the equipment for the common high school sciences were judiciously selected, there would, in many cases, not only be more money available for the equipment of the new work in agriculture, but the pure science laboratories themselves would be quite as effectively fitted.

It is true, however, that adequate provision for agricultural teaching in the high school requires a greater

expenditure than does any one of the other sciences. To equip and to maintain an agricultural department properly requires more money than is required for a pure science. Provision must be made for both indoor and outdoor work. Teachers of vocational work are obliged to have a combination of practical and theoretical training and must not only be paid more than skilled workers in the vocation which they are teaching, but more than the teacher of a non-vocational subject.

Instruction in agriculture or any other vocational subject cannot be as widely introduced or as efficiently carried on as is desirable in this country if supported only by local or private enterprise. Nor is it right that it should be so supported. The pupils of our public schools do not necessarily settle in their own community to live their lives or do their life work. Conditions are such that they may easily go from one locality to another — from one state to another. A boy vocationally trained in the schools of one community may benefit another community by his skill and thrift. All communities, all states, should be equally interested in vocational training. It has been shown that this kind of training is as necessary for the best prosperity of our nation as is the training afforded by the old system of education. The states should therefore contribute to the support of these vocational courses in the public schools. It is even asserted that the national government itself may

legitimately be called upon to aid this form of education.[1] It already contributes to vocational education in engineering and agriculture in the colleges. It is both desirable and expedient that it should contribute to the work farther down the line. The Davis bill, introduced in Congress in 1910, and the Page bill of 1911 were efforts to secure federal aid for high school instruction in agriculture.

Several states are already contributing to the support of the agricultural work, not only in special schools but in the regular high schools where such work is introduced.[2] Other states must inevitably fall in line as soon

[1] Snedden, David, "Problem of Vocational Education," p. 67.

[2] For example, in 1910 the Legislature of New York State passed an act providing that any public school above the elementary grades that established industrial training shall receive from the state $500 for each independently organized school or department of agriculture, mechanic arts, or home-making employing a teacher for that work exclusively, and $200 for each additional teacher.

In 1908 the Virginia Legislature made an appropriation of $20,000 per year for two years, to enable the State Board of Education to establish industrial courses in at least one public high school in each congressional district. Nearly all of the money went to established high schools. In 1910 the appropriation was increased to $30,000 annually, and, for the year 1912, $25,000 was appropriated for buildings and equipment for these schools and $10,000 for extension work carried on by them.

The Putnam Act, passed by the Minnesota Legislature in 1909, provided state aid to the amount of $2500 to each of ten high schools, or consolidated rural schools, which would maintain suitably equipped agricultural and industrial departments. The state pays two-thirds the expense to maintain such departments, but not to exceed $2500 each year to each school. By legislative act of 1911, the number of schools aided

as the profitable nature of such state investment in industrial education is more fully realized. For, as stated by

was increased. The Benson-Lee Act of 1911 gives $1000 each to fifty other Minnesota high schools for maintaining satisfactory courses in agriculture.

In 1910 the Legislature of Louisiana passed a law for the encouragement of agricultural teaching in high schools and voted $50,000 for the period 1912–1913 for aid to schools maintaining a course approved by the State Board of Education.

In 1911 Kansas made an appropriation of $50,000 for 1912–1913, for the purpose of granting $250 state aid to each high school that established a one-year course in agriculture, and a one-year course in domestic science.

The Maine Legislature has provided that any free high school or incorporated academy in the state maintaining an approved course in manual training, domestic science, or agriculture shall be entitled to receive annually from the state a sum equal to two-thirds the amount expended for such instruction up to $500.

The Maryland Legislature provides state aid for agriculture and other industrial subjects in two classes of high schools. In schools with at least eighty high school pupils and a four-year course of study the state gives $400 towards the salary of each of two special teachers, and to schools with at least thirty-five high school pupils and a three-year course of study, $400 towards the salary of one special teacher.

The Massachusetts Legislature has appropriated $10,000 per year to aid in the support of vocational agricultural departments in selected high schools. Towns providing such approved departments will be reimbursed by the state to the extent of two-thirds of the amount of salaries paid to agricultural instructors.

The North Dakota Legislature provides for state aid to the amount of $2500 annually to each high, graded, and consolidated school to establish and maintain a department of agriculture and other industrial subjects. A requirement is that the school have at least ten acres of land suitable for a school garden and purposes of demonstration. Funds have not been available for this state aid up to 1913.

The new school code of Pennsylvania requires that all township high

Dr. True, "If literary education has been a profitable investment for the American public, industrial education is likely to prove a bonanza."

In discussing the agricultural equipment of the high school we may perhaps most profitably consider it under four heads: (1) the laboratory; (2) the school farm; (3) the agricultural library; and (4) illustrative exhibits. In addition, the community surrounding the school also affords valuable materials for study by agricultural students, and these should be utilized as far as is profitable; but since none of these outside illustrative materials have to be purchased by the school or belong to the school, we shall not consider them here.

The purpose of the laboratory and its equipment is to furnish a workroom and means for demonstrating agricultural truths and performing exercises through which students discover agricultural truths for them-

schools receiving state aid must teach agriculture in a manner acceptable to the State Department of Public Instruction. The amount received varies from $400 to $800 annually.

Texas authorizes public high schools to teach agriculture, manual training, and domestic economy and appropriated $50,000 to aid in establishing such departments during 1912–1913. It gives not more than $2000 to any one school during the year, and such appropriation shall not be made more than twice to the same school.

Wisconsin provides state aid to the amount of $250 annually for each department of manual training, domestic science, or agriculture established in connection with any free high school. Where such departments are also maintained in the three grades next below the high school, $350 annually may be received.

selves or verify facts learned from the text or the teacher. In order that the work may be properly performed, the room and its furnishings should be suitable and all needed apparatus and materials should be provided.

Certain of the materials and apparatus used in the physical and biological laboratories may form the basis of that used in the agricultural courses. Not all the equipment needed for chemistry, botany, physical geography, physics, etc., is needed in the agricultural work, but certain kinds of apparatus and materials used in each of the pure sciences commonly taught in the high school are needed in the work of the agricultural laboratory. In the case of these, a list of the kinds and amount of materials needed may be made out annually or oftener by the agricultural instructor and given to the principal or the heads of the various science departments, when it may be added to their orders and used as needed by the agricultural department. Or the agricultural department may order these separately. The same is true of the apparatus needed by both the agricultural and some other departments, as, for example, microscopes, needed by both the botany or zoölogy and the agricultural departments. In most schools it will probably be found not only a matter of economy to have the same apparatus serve two teaching departments of the school but also perfectly satisfactory as regards use. However, where there is any doubt as to apparatus

properly serving the two or more teaching departments, the apparatus should be duplicated.

The agricultural laboratory will, however, need other materials and apparatus in addition to those used in common with other departments. Some of these must be purchased, but others may be obtained by a little work and trouble. Soil samples for study and experiment may be had for the trouble of collecting them. Many ordinary farm seeds may be secured from the school farm or from farmers of the district. Their collection and preparation for use by students will be both a matter of economy for the school and of education for the student. Of the special agricultural apparatus, it will be necessary to purchase such items as the Babcock tester, the cream scale, soil thermometers, and some others. But many needed things can be made by students of the manual training department of the school or by the agricultural students themselves. However, the time and labor of students should be used for making apparatus only when such work will have some educative or training value. If it has no such value, the apparatus should be purchased or some one hired to make it.

One large agricultural laboratory, properly fitted, may be made to serve for all the agricultural courses of the ordinary high school with the exception of dairying. For this a special cement-floor room should be provided,

properly equipped with the necessary appliances of the modern dairy. In a large school it would perhaps be desirable to have a special agronomy laboratory, a farm management laboratory, and so on; but one room equipped for work in the different courses may be made to serve very well, and usually this is all that can be provided.

If possible, the laboratory should be near the ground, with easy access to the outside of the building, to a greenhouse, and to a workroom where grosser materials than those suited to the laboratory may be handled. This workroom may be connected with the greenhouse or may be in the school building, if provided with an outside door. In some climates a greenhouse may not be necessary, if a lath or canvas house is substituted for it. One of the three is necessary, however, for any school giving agricultural work of any extent in plant propagation and similar work. Adjacent to the laboratory there should be a small room properly fitted with cabinets, shelves, etc., for the storage of apparatus and supplies.

The laboratory and its fittings should be such as to meet the requirements of the various kinds of agricultural experiment or demonstration work (botanical, chemical, etc.). Ample space and accommodations should be provided for work by all the individuals in a class. The room should be well lighted. There should be suitable desks, tables, chairs, a blackboard, drawers, shelves,

lockers, sinks, etc., for the work in soil physics, plant growth and development, and other studies. Either gas burners or alcohol lamps should be provided in sufficient numbers to supply each worker in the laboratory. Drawing tables should be furnished either here or elsewhere for the use of students in farm architecture, general farm management, and for certain phases of the work in other subjects.

All laboratory supplies for the year should, as far as possible, be secured and in readiness for use at the opening of the school year. In making up a list of laboratory supplies for the agricultural work, the teacher should go over carefully the outline of the work of each course to be given and note what apparatus and materials will be needed, at the same time determining the probable amount. In doing this he will be greatly aided by the lists of laboratory supplies for agricultural courses published in connection with printed outlines of work in different schools, by the lists accompanying syllabi of state education departments, in bulletins published by agricultural education departments of colleges, in textbooks, laboratory manuals, and in the catalogues of reliable school supply houses. But though these will be helpful, local conditions and needs and the special work planned must determine the supplies to be secured.

A second essential in the agricultural equipment of a high school is a school farm. The purpose of the school

farm is, among other things, to serve as a place where farm crops can be grown for illustrative purposes and where practice work can be done by agricultural students. Though frequently lacking, it is a very necessary part of the agricultural equipment. The weak point in vocational training in the schools has been practice work. While strong in its ability to impart the theory or abstract phases of a vocation, the school has not given proper attention to training in doing, and for that reason its vocational work has often lacked effectiveness.

The school farm may be large or small, depending on needs and on the funds available for its purchase and maintenance. It should be distinct from the lawn and playgrounds immediately surrounding the school, though it may be adjacent to them. The general oversight of these grounds will probably fall to the agricultural department, and students will doubtless do some work on them. But their real purpose is to serve as a setting for the school building and for the general recreation of students. They should illustrate permanently and pleasingly the elementary principles of landscape gardening and should present at all times a well-cared-for, attractive appearance. A part of the grounds should be set aside for sports and recreation of various kinds; but they should not be made to serve the purpose of a school farm or be confused with it.

The size, buildings, equipment, and use of the school

farm or agricultural grounds will depend upon many factors which we shall not discuss here. (See Chapter XII.) It should be stated, however, that the farm should be of sufficient size and suitable equipment to provide for a wide range of practice work for students, adapted to the work of the different agricultural courses. It should have buildings adequate for storage of tools, housing of live stock owned by the school, a greenhouse or lath house, and a room or shop for farm mechanics work, repair of tools, etc. Certain other buildings, such as a farm dwelling, are also desirable, if the size of the farm warrants them.

A third important part of the equipment of the high school giving agricultural courses is found in its agricultural library. Ordinarily, too little attention is given to it. It should be shelved with the other books of the high school library in a quiet, well-lighted room set apart for the purpose. This room should be supplied with chairs and tables, where books and bulletins can be consulted in comfort and periodicals looked over. All books should be carefully classified (preferably by the Dewey decimal classification system which is commonly used in public libraries), and a complete card catalogue, including author and subject entries, should be available for consultation. The book shelves should be neat and well made, uniform in character, and such that all books are easily accessible to students.

If there is a large collection of bulletins and circulars of the various state experiment stations and the national Department of Agriculture, they should be arranged in order by number under the proper bureau, office, or station, and each set given a classification number. They should then be catalogued fully in order that the valuable material contained may be readily accessible. The bulletins should be kept in pamphlet boxes or in temporary binders until a certain number, or publications covering a certain period, have been acquired. They may then be bound permanently. However, if the bulletin collection is very small and scattered, each may be put in a manila cover, classified and catalogued in the same way as a book.

Agricultural periodicals, if of but temporary interest, may be saved for a few months and then disposed of as the teacher sees fit. If of permanent value, they may be bound every six months or every year.

The catalogue and care of the agricultural library will probably not fall to the agricultural teacher, but to the school librarian or to some other teacher to whom library duties are assigned. These suggestions are not out of place, however, for the agricultural teacher should know how to care for the agricultural book collection.

Both books and bulletins should be generously supplied in the agricultural library; and some agricultural papers and periodicals should be received regularly. The book

list should be well balanced, including books on all the various subjects of instruction, — animal husbandry, field crops, horticulture, general plant study, farm management, etc. Books should be well written, up-to-date, and, as far as possible, adapted to the comprehension of high school pupils. Certain books quite beyond the student may, however, be included in the library for the teacher's use, that he may select material from them and present it to students in suitable form.

Before selecting his book list, the teacher should go over the agricultural studies to be taught and make a note of the more important publications on the topics of instruction suited to the needs of his students. He may also secure lists of books in other high school agricultural libraries to help him in selection. Many such lists, together with "model," or especially recommended, lists, may be found printed in bulletins of agricultural education departments of colleges, in syllabi of state education departments, etc. Excellent short lists of reference material are frequently found in books and bulletins on special topics, as, for example, that on corn at the end of Farmers' Bulletin 409, that on tree literature at the end of California Circular 59, and others. The catalogues and announcement lists of the various book firms should also be secured regularly, and those agricultural books which promise to be of most value

should be examined as soon as possible to determine whether their purchase for the school will be advisable.

Having made out the list of books desired, the agricultural teacher will probably find that funds are available for the purchase of only a small part of them. He must then choose from his lists such as are most needed for immediate purchase, and secure the others as soon as funds are available.

Fortunately, much valuable material for the agricultural library can be secured free, in the form of bulletins and circulars. The agricultural teacher should write to the state experiment station and ask to have the school placed on the mailing list, that it may receive regularly all bulletins and circulars of the station as issued.

He should secure, from the United States Department of Agriculture, the "Monthly List of Department Publications," and the "Monthly List of Experiment Station Publications," both of which are sent regularly to all who apply for them. In addition, he should secure from the department Circular 2 of the Division of Publications, entitled "Publications for Free Distribution"; Division of Publications Circular 3, "Publications for Sale"; Office of Experiment Stations Circular 94, "Free Publications of the Department of Agriculture, classified for the Use of Teachers"; and Office of Experiment Stations Bulletin 180, "List of Publications of the Agricul-

tural Experiment Stations, . . . to June 30, 1906." From the last four of these he will be able to select such bulletins and circulars as have been published in previous years and as are suited to his needs. The "List of Publications of the Agricultural Experiment Stations" will, however, have to be brought up-to-date by consulting the monthly list from June, 1906, to date.

By means of the two first-named lists the teacher will be enabled to note all new publications of the experiment stations and the national agricultural department as they are printed and may send for such as he desires for his school library.

Many publications of value to the high school agricultural teacher are issued by state departments of education, state agricultural boards, etc. All such are listed, together with many others, in a monthly publication issued by the United States Library of Congress, Division of Documents, entitled a "Monthly List of State Publications."

As to the periodicals and papers to be secured for the school agricultural library, free copies will very likely be donated by the publishers of some of those desired. The others may be subscribed for by the school, or by agricultural classes. The quality of such periodicals as are found on the library tables should be of the best. It is far better to have one good periodical or paper than a dozen poorly written ones, perhaps including much

inaccurate material. There should be at least one periodical or paper of special local or state interest agriculturally, another dealing largely with the leading interest of the community (as horticulture in a horticultural district, dairying in a dairy district, etc.), and others of general scope. The school should also receive, without fail, the Department of Agriculture periodical, "The Experiment Station Record," which gives monthly reviews of station and government bulletins, of circulars on agricultural topics, and of important periodical articles and books on agricultural chemistry, field crops, horticulture, zoötechny, dairying, veterinary medicine, agricultural education, rural engineering, and related topics.

The agricultural library should, then, be comprehensive, up-to-date, properly arranged and cared for. It must also be *used*. Students must be instructed in the use of books and bulletins and their attention frequently directed to the agricultural library. Noteworthy articles in periodicals should be mentioned in class as soon after the periodicals have been received as opportunity offers. In every way possible the student should be led to appreciate the value of good agricultural literature, to understand how to use it and to know its sources.

Frequently the public library of a town is very glad to coöperate with teachers in any way possible, and if the library funds of the school are inadequate and it is im-

possible to secure for the school all the books which are needed, the public library may be induced to buy at least single copies of books, and in some cases duplicates. Students may then be referred to the books in the public library and be sent there to do reading occasionally.

Last in our consideration of the agricultural equipment of a high school, but by no means unimportant, come illustrative exhibits. Fortunately, these usually cost little but time and care. Provision must be made, however, for suitable cabinets, shelves, cases, etc., for preserving the exhibits. If a small room of suitable size is available, it may be properly equipped and the exhibits may be kept there; or a portion of the library may perhaps be used; or they may be stored in a part of the agricultural classroom, or even, if necessary, in the school corridors.

The exhibits will naturally differ in every school. They should include many illustrative materials that will be helpful in the instruction in agriculture and that may not otherwise be available when needed. Specimens of local farm products, properly preserved, such as fruits, vegetables, grains, etc., should be included, as also exhibits of some of the more important agricultural products raised elsewhere. If possible, it is desirable to have each kind of product represented by several different varieties. Exhibits of soil samples, injurious insects,

weed seeds, economic seeds, and mounted specimens of troublesome weeds should find a place in the collection. Mounted illustrations or photographs of farm buildings, with plans, may well be included, as also models of farm buildings, building specifications, etc. Pictures of farm machinery, plans for the layout of farms, and many other useful exhibits will suggest themselves.

Excellent educational exhibits, valuable as illustrative material for agricultural classes, may frequently be secured free of charge from the manufacturers of certain products. Examples of these are the exhibit of cereal products prepared by the Postum Cereal Co., Battle Creek, Mich.; that of corn products prepared by the Corn Products Refining Co., Chicago, Ill.; and that of cattle products which can be secured from Morris and Co., Union Stock Yards, Chicago.

All exhibits should, of course, be carefully labeled, arranged, and catalogued. They may then be readily noted in class work and referred to easily by students. The exhibits should be kept up-to-date just as carefully as is the agricultural library. Useful material should be watched for and added as opportunity offers. The materials preserved should be really valuable in illustrating the agricultural teaching of the school and should be referred to at every opportunity that they may become familiar to students.

PRACTICUMS

1. After study and comparison of the various ways in which state aid is given to agriculture in the public high schools of the United States, outline the legislation along this line that you consider best suited to needs and conditions in your own State.

2. Make a $50 list of books for the agricultural library of a high school of approximately one hundred pupils, where a full four-year course in agriculture is given, including beginning agriculture or agronomy, animal industry, horticulture, farm mechanics, and farm management. Select four agricultural periodicals to be subscribed for regularly in such a school.

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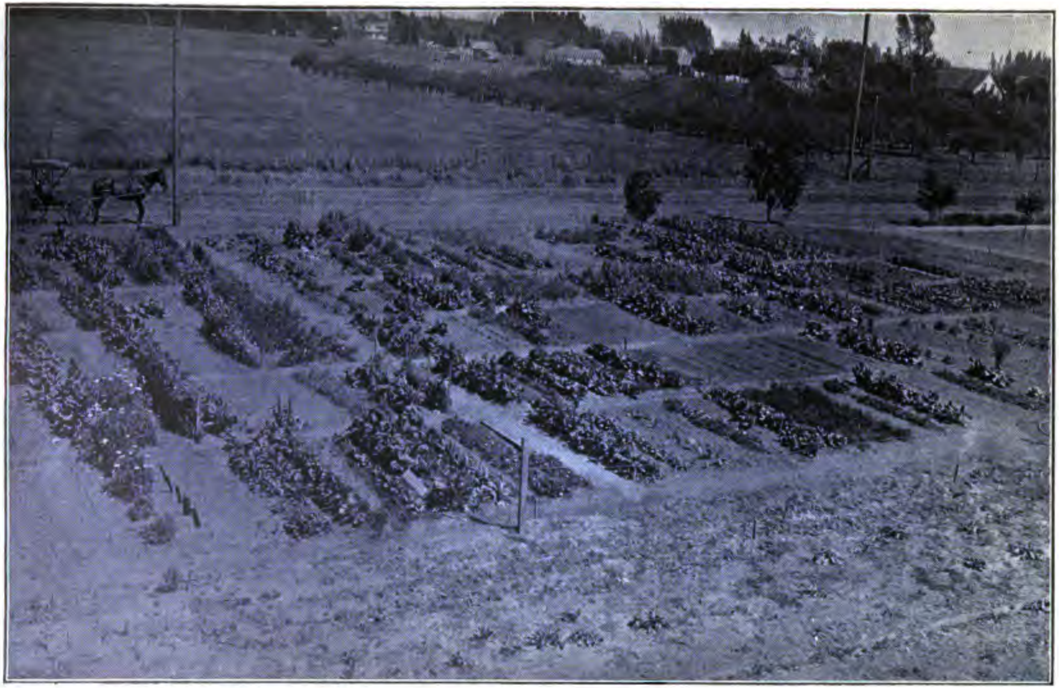
CHAPTER VI

THE FIRST YEAR AGRICULTURAL WORK

HAVING considered in a general way the organization of the high school course in agriculture and the equipment for it, we may next take up in some detail the various subjects of the course.

The first year work in agriculture must necessarily lay the foundations for the work which is to follow. It must be elementary, yet scientific and thorough in its presentation of selected topics. Since the growing of plants is the basis of agriculture, the study of plant life naturally precedes other agricultural study. The materials of the first year agricultural course will therefore center about the growth and development of plants and the study of their environment. Even though we assume what is, though desirable, not always the case, — that elementary agriculture has been taught in the grades either as agriculture or under the guise of nature study, — yet a more thorough, scientific study of plant life and growth should be given during the first year of the high school than is possible in the elementary or grammar grades, with their limited equipment and unexpert instructors.



School Garden, Gardena High School.

This is desirable not only because of the better equipment available in both the high school laboratories and library, and the clearer development of the scientific basis of agriculture possible because of it, but also because of the possibility of greater thoroughness through more frequent and longer recitation periods and the improved grade of instruction possible where the agricultural work is given by a trained, scientific agriculturist.

This beginning plant study is given under different names in different schools. Very similar work is known in different places under such terms as beginning agriculture, beginning agronomy, or agronomy, farm crops, agricultural botany, general science, and other names. In still other schools the work is split up and given in different terms under such heads as agricultural botany, soils, agricultural chemistry, agricultural physics, etc. The matter is, to be sure, more important than the name, yet it is regrettable that this lack of uniformity in nomenclature exists. From it arises much confusion and lack of understanding as to the work now being done and which it is desirable to do in the beginning and other agricultural courses of the high school.

Moreover, although in many schools practically the same kind of beginning agriculture work is taught very successfully under various names, yet in many cases the first year work is very unsatisfactory. Unexpert teachers, though perhaps well informed agriculturally

and scientifically, lose sight of the great purpose of the beginning course and the psychological and other reasons which should determine its subject matter. They choose among the names applied to first year agricultural courses that which appeals to them most, farm crops, for instance, or soils, and they start a course under that name. And though excellent beginning courses are being given in many parts of the country under such names, yet in the hands of many teachers who follow the name rather than the subject matter, such a course becomes too highly specialized for a beginning course and fails to lay the desired foundation for the work of later years. Or, going to the other extreme, teachers sometimes give preparatory courses so general that they take up animal life, plant life, farm mechanics, and farm management, including so much that the course fails in its real purpose. It is inadequate as a preparation for future work, failing to fix important basic principles and degenerating to a mere collection of agricultural facts, the scientific foundation and principles of which are little understood.

We need a uniformity of nomenclature and a certain degree of uniformity of subject matter in our high school agricultural course if a well-organized, well-balanced course of study is to be secured. Agricultural teachers' associations should adopt a definite nomenclature which will be as readily understood by

teachers in one part of the country as in another, and which shall be understood to indicate certain definite lines of work. The time given to the various phases of work included in each course will, to be sure, vary greatly with different teachers and pupils and in different localities. But there should be sufficient uniformity in the nomenclature and subject matter to make the character of the work in the agricultural course in any school clear to those interested in similar work, even though they be at a distance.

The name to be chosen for the first year course is a matter of the greatest difference of opinion, even among those interested in securing uniformity. *Beginning Agriculture* is suitable, but has been so frequently used for a beginning course including both plant and animal study that there is some objection to it on that account. *Agricultural Botany*, though used for this course, is ordinarily understood to mean something far different and much more technical than this first year's work is intended to be. Moreover, the term "botany" too greatly limits the work. *Farm Crops* is also undesirable in many ways. It is both too limited and too broad a term. *General Science*, though it describes the work well, in a way, is objectionable from the point of view of the agriculturist. *Beginning Agronomy*, all things considered, is perhaps as good a term as can be chosen. For agron-

omy, in a broad sense, according to the definition given in Office of Experiment Stations Circular 32, is a "study of climate, soils, fertilizers, and crops, that is, of plant production."

In Office of Experiment Stations Circular 77, an outline is given for a secondary course in agronomy. This deals, as we should expect, with plant growth and development; and though the outline as given presupposes some study of botany, yet, with certain modifications, it may be adopted as a basis for first year work. Local conditions and needs and the previous preparation of pupils will, however, in any given case determine the amount of time to be given to any topic and the emphasis to be placed upon it. In actual teaching it will also be found advisable to change the order of topics to some extent.

This outline takes up first the composition, structure, physiology, and heredity of the plant; and the light, heat, air, moisture, soils, plant foods, and repressive agencies of the plant environment. This is followed by more or less study of the various classes of economic plants and of individual local crops and their rotation.

Considering the outline from the standpoint of agriculture, it is found to suit the needs of a beginning course admirably in a general way, though, as has been said, it needs a certain amount of modification in arrangement in actual teaching. It furnishes a good arrangement for

the study of plant growth and development from an agricultural viewpoint and abundant opportunities for the study of plant environment and improvement. A wealth of most interesting laboratory and field work is suggested by the topics, and the work is such that it promises both a firm foundation for future work and a sure appeal to students' interests. Although the outline may seem to begin with topics beyond the ready comprehension of first year high school pupils, yet experience has proved that, treated in the right way, the essential facts as to plant composition and structure are readily understood by pupils of this grade. Frequent laboratory demonstrations by the instructor at the beginning of the course appeal strongly to the pupil's interest and enthusiasm, and when, a little later, individual laboratory work and outdoor practicums are taken up by the class, this interest and enthusiasm is increased and made permanent.

But the outline is also admirable from another point of view, — that of the teacher of science. We find, on analysis, that it may be made to furnish an excellent outline for a beginning science course as well as for the beginning agriculture course. In fact, it appears to be just what science teachers have long been trying to find; that is, a satisfactory introduction to the science work of the high school.

For years it has been admitted that the teaching of the

physical and the biological sciences in the high school has been unsatisfactory in many ways. The educational results of high school science are not what was hoped and predicted when it was introduced into the high school curriculum. In many schools the number of students electing such work is falling off. The materials used are criticized as not sufficiently related to the life and needs of students. The teaching methods employed are said to be too frequently adapted to the college rather than to the high school. The results attained are often called unsatisfactory, both as to the knowledge gained by the student and as to his attitude toward further scientific work. This failure is ascribed to the demands of the colleges on high school science work, to the need of a well-perfected method of science teaching, and to other causes. It is not our province to discuss these, but we are interested in the high school science situation inasmuch as it has been proposed to remedy the unsatisfactory conditions through agriculture. For example, it has been proposed to improve the high school science work by teaching the sciences in the high school more as applied sciences. This is being advocated by numerous school men and is without doubt a good suggestion. It is still further urged by some that the applications be to agriculture, and that this application take the place of agricultural courses in the high school. Many science men favor this, but it is approved by but

few agriculturists. It enriches the science work to a certain extent, but it is not fair to students who want agricultural instruction to give it to them in this way. Agriculture thus taught would be unorganized and would inevitably appear to the mind of the student as a mere patchwork of fragments of the various sciences, or as an appendage to them. Moreover, many of the important facts of agriculture would not be taught at all. For the other sciences do not provide for instruction in farm machinery, stock judging, seed selection, and many other topics. Agriculture is itself a science, and though the other sciences shed a necessary light upon it, agriculture should be taught as a separate science. It is, in addition, an art, and, if taught efficiently, other methods must be employed in instruction as well as the ordinary methods of science teaching.

Still another suggestion made by school men some years ago for the improvement of the science work in high schools was the giving of a general science course in the first year. It was evident that one of the greatest difficulties in science teaching lay in the fact that the various science courses as taught in most high schools were too isolated from the experience of the pupil and from each other. Each was abstract and to a certain degree helpless within its own department. Moreover, the various sciences used a language with which pupils were unfamiliar. As a result, the science work did not

appeal to pupils, nor did it do for them what was expected in the way of educational training.

With first year high school pupils especially, science work failed to prove attractive or beneficial. Such students are naturally superficial. Though their interests spread over a large area, they do not go very deep. They are interested in the many wonderful and fascinating things in the world about them and wish to understand them. They like to experiment, to see demonstrations. They like studies related to life. Formal science work, unrelated to life, does not appeal to them. It is therefore important, during this first high school year, on the threshold of the work in science, that the student be happily introduced both to the mysteries and methods of science. It is important that his first impressions be favorable. Otherwise he is apt to turn aside from science in his future work and to miss much training which he needs and should have.

Since biology, physiography, and physiology are more nearly related to life than the other scientific subjects, it seems that these ought to prove interesting to first year high school students. Yet, though they led for many years as first year science, they were not found to be wholly satisfactory. Though they deal with real life and conditions, yet observation and experience show that they do not have the universal appeal desired. Moreover, each of these, to be most effectively taught,

requires some knowledge of the other sciences; and each of them appeals to a student only so far as his life has turned his interests in these directions.

No one of the high school sciences, then, as ordinarily taught, leads to that experience which makes science seem a fairyland to the young pupil, and none gives him as broad a view as he should have. No one subject alone, experience seems to indicate, so stimulates the imagination, fires the interest, and engages the attention as would a wise selection from the whole field of scientific knowledge. In view of this, the suggestion was made, something over a decade ago, that the first year science work might well be a general introduction to science, having its roots in all the high school sciences. It could thus, it was argued, be made interesting, practical, full of demonstrations and laboratory experiments which would appeal to the interest, arouse the enthusiasm, and increase the desire of the pupil for more and deeper knowledge. A background would thus be given for the scientific studies; they would be related to the child's experience and environment and to each other; and students would be prepared for the more formal and specialized study of the various branches of the high school sciences.

All over the country, school men recognized the need for such a course and its advantages as a preliminary to future science study. Courses governed by these

ideas were introduced in various places, sometimes with great success. But though the ideal was good, it was soon found that there was danger of giving series of disconnected lessons and, unless the teacher was a particularly strong one, of not getting the desired results. The work was apt to be unbalanced, disconnected, and too much influenced by the teacher's special interests. There was, ordinarily, too little emphasis laid on the *oneness* of science. There was needed a connecting thread which should give unity and balance and purpose to the work in the minds of both teacher and students.

And here, we believe, is where the agriculturist and the science teacher can join forces. A proper beginning course in agriculture, or agronomy, presents work which not only meets the needs of the agricultural course, but which offers a fitting gateway to the various fields of science. A beginning course may be so taught as to give the student information concerning the elements of the so-called high school sciences, and may also present a thoroughly unified study of the elements of that science and art which is the most fundamental of man's occupations, — agriculture. First year agriculture, or agronomy, properly presented, not only includes direct applications of botany, physics, chemistry, biology, geology, etc., but gives a needed incentive to study and interest. It not only presents and teaches certain scientific facts, but it provides values for them. By using such a course

we may not only serve the educational purposes of first year agriculture and first year science to the best advantage, but we may economize both time and money. The same beginning course may be given to all students whether they are to specialize in agriculture, domestic science, science, or other studies. Economy of time, materials, and teaching energy thus characterizes the most satisfactory form of instruction.

Though as agriculturists we are primarily interested in agriculture and in the first year agricultural subject as a part of the high school agricultural course, yet it is both interesting and gratifying to note that in the ideal beginning agriculture course we have found an ideal general science course. We must, however, never fail to emphasize the fact that though beginning agriculture or agronomy, properly taught, is general science, it is not *merely* general science. It is something more. For while the average general science course, though it may serve more or less satisfactorily as an introduction to the various sciences, lacks, as has been indicated, both unity and purpose, and there is danger that it may prove merely a conglomeration of more or less interesting scientific facts, the agricultural course, though it gives an ideal introduction to the various sciences, also provides additional values for the work. It provides an economic as well as a cultural motive for further scientific study. It emphasizes the usefulness of scientific knowledge.

It furnishes an opportunity for comparison of agricultural with other occupations, thus contributing towards a wise choice as to personal vocation. Better than the best of the non-agricultural general science courses, first year agriculture or agricultural general science interrelates the various special sciences. For though the ordinary general science course has certain advantages as to materials selected over any one of the separate sciences, yet even here the relations of the different sciences one to the other are but poorly brought out. It is difficult for the student to see the relation of his science studies to each other and to life, their educational or practical value. But first year agriculture, properly taught, so draws on all the high school science subjects that their educational values and their interrelations are clearly discovered to pupils.

For example, some knowledge of soils must come early in the agricultural study of plant life and development. In order to attain this, the student must go to the fundamental earth-science, geology, and to physical geography for information concerning soil formation. Biology also comes in here, with a study of the work of plants and animals, such as the earthworm, in soil formation. For a knowledge of the elements which compose the soil and upon which the fertility of the soil depends, the student must go to chemistry. The physical properties of soils bring up a study of various facts and principles of

physics. The agricultural importance of the soil is as a part of the plant's environment. Its fertility is evidenced by its ability to produce plants. Understanding of the growth and development of plants necessitates a knowledge of many of the elementary facts of botany. Successful dealing with the repressive agencies with which plants have to contend brings in entomology. And so we might go one almost indefinitely, showing how whatever agricultural topic we may be studying reaches out for explanation and understanding, not only to one, but to several of the sciences, and, in addition, is enlivened and made vitally interesting by its relation to human experience and human needs.

Lastly, in common with the best type of non-agricultural general science, first year agriculture provides an interesting and varied form of laboratory work and field observation at the beginning of the high school course. The pupil is thus gradually acquainted with the more common language of science and is early shown the fundamental importance of investigational evidence in all science work.

All this deals with the value of the course for agricultural and science students. But the value of the course is not for them alone. So much of agriculture as is embraced in a first year agricultural course of the kind under discussion should be known to every high school student, whether boy or girl, as a matter of general in-

telligence, information, and culture. Whether in the city or country, the high school girl should at least learn something as to the source materials from which come her daily food supply. Equally, the future man of any occupation should be educated to an understanding of the most fundamental of all occupations and its relation to other industries and vocations.[1] After this preliminary year's work, more specialized work in either agriculture or domestic science can be logically and systematically developed for those who wish to elect such courses, and the high school science course can be developed economically, rationally, and pedagogically for science students. In addition, those students who are not aroused either to a desire for the special work in science, agriculture, or domestic science will at least have received a little valuable training in habits of accurate observation, of thinking to conclusions, and an elementary knowledge of the things which surround them.

To agricultural students, then, such a course offers excellent preparation for vocational work; to science students it gives an admirable preparatory course; and for general students it serves as a valuable culture course.

The proof of the asserted values of such a course can be seen, naturally, only in actual observation of its teaching.

[1] Editorial. Agriculture as First Year Science. Experiment Station Record, v. 23, No. 3, p. 206.

The reasons for the appeal which the work makes to the student's interest are, however, not hard to understand; and the practical teaching advantages of the work are becoming more and more apparent with its continued testing.

To show more clearly how this first year agricultural course may be made to serve the purposes indicated, there is given below an arrangement of work which has been successfully tested by the writer in two high schools. Column 1 is a very free modification of the agronomy outline, in Office of Experiment Stations Circular 77, to which reference has previously been made. Columns 2 and 3, parallel with it, were worked out in giving a first year agricultural course in the high school, and the materials indicated were tested with different classes with very satisfactory results. Column 1 may be said to represent the agricultural aspect of the course; column 2 is made up of suggestions as to scientific facts and principles which may be presented in connection with the course, — that is, it represents the general science aspect of the course; and column 3 consists of suggestions as to experimental work in the laboratory and field, class demonstrations by the instructor, field trips, etc.

It should be understood, however, that this outline does not attempt to indicate all of the valuable laboratory and demonstrational work and field practicums

that might well be given during the course. The topics in both columns 1 and 2 will suggest to the alert teacher others which might profitably be given. Nor is it asserted that those chosen are the best under all circumstances. Those noted are merely intended to be suggestive, though they have all been successfully used in giving such a course in high schools. If but one class period per day is given to the work, the amount of the laboratory and field work possible will be considerably less than that indicated in the outline, and it may be well to change the character of many exercises. Even with two daily periods, it may not be possible to cover as much ground. Time may, however, be economized by increasing the number of demonstrations by the instructor or by individual pupils. Yet, to secure the best results, a generous number of the exercises and practicums must be performed by each member of the class.

It will, obviously, be found impossible to treat in much detail the scientific facts and principles listed in column 2, the general science aspect of the course, in addition to doing practical agricultural work. But a generous selection should be made of such of them as seem to fit in best with the work and such as seem most needed by the class in connection with present or as a preparation for future work. The practical agricultural phases of the work and the attendant practicums and laboratory work must overbalance the purely scientific

aspect of the work; and the agricultural value of a particular fact or experiment must be the guiding principle in the selection of the materials of the course. Yet even the treatment of the strictly agricultural topics must necessarily be greatly limited. Only the fundamental principles and basic facts can be taken up under each topic. A general understanding of the processes of plant growth and the conditions of its environment, together with an appreciation of the scientific basis underlying them, some little knowledge of a few special crops, a fair amount of deftness in laboratory and other practical exercises, ready and accurate observations, and the formation of right ideas as to agriculture and country life, — this is as much as should be expected from the course.

The work of the course will, as is evident from the outline, consist of lectures, reading assignments, laboratory demonstrations and experiments, school farm and garden work, and field trips or excursions. No suitable textbook is at present available for such a course, though certain of the better high school agricultural manuals may be profitably used in connection with some phases of the work.

The amount of time to be given to the course should be not less than one class period of forty to fifty minutes daily throughout the year, and should preferably be two periods. This time may be divided between laboratory,

Outline of First Year Agricultural Course, Plant Study forming the Basis

(Suitable also for a general science course, thus serving two purposes at the same time.)

The agricultural aspect of the course.	The general science aspect of the course. Suggestions as to a few of the scientific facts and principles which may be taught in connection with the agricultural work.	Suggestions as to demonstrations, laboratory work, and field trips and excursions.
Introductory talks on what agriculture is, the dependence of other occupations on agriculture and of successful agriculture upon science.		
The Plant		
1. Composition of the plant. *a.* Essential ingredients. Elements necessary to plant life. *b.* Water. *c.* Ash. *d.* Protein. *e.* Carbohydrates. (1) Cellulose. (2) Starch. (3) Sugar. *f.* Fat.	1. Chemistry and physics. Composition of matter. Physical and chemical changes. Characteristics of the thirteen elements necessary for plants, — their occurrence, preparation, properties, and importance. Composition of water. Physical properties of water. Forms of water. Water content of plants. Indestructibility of matter.	1. Demonstrations by the instructor before the class, illustrating physical and chemical changes, the preparation of oxygen, hydrogen, etc. Time should not be taken here to prepare all the essential ingredients of plants, though pupils should be informed as to the more important properties and characteristics of each.

(The work in plant composition is, needless to say, taken up in a very simple, elementary way, fixing only essential facts in an interesting way.)	Definite proportions. Ash the mineral residue left after combustion. General topic of combustion. Combustion as rapid oxidation. Slow oxidation. Chemical tests for protein, starch, sugars, fats, etc., may be made here, but should preferably be deferred until the study of seeds as food. May also, if desired, take up the occurrence, chemical properties, physical properties, function, value, etc., of the organic compounds of plants.	Demonstration of the separation of water into its component parts, of different forms of combustion, etc. Pupils become acquainted with a few scientific terms and with certain apparatus and materials. Individual pupils take part in demonstrations by assisting in various ways. Practice in careful observation and recording of demonstrations in note-books.
2. Plant structure. The parts of the plant. Characteristics and functions of its parts. What is needed that they may do their work most successfully. Economic uses of each part. *a.* The seed. *b.* Roots. *c.* Stems. *d.* Leaves. *e.* Flowers.	2. Botany. Organs for particular kinds of work. Vegetative organs of the plant. Reproductive organs of the plant. Pollination. Botany and zoölogy. The cell. Cell division, growth, and reproduction. Entomology. Relation of certain insects to fertilization.	2. Examination of different kinds of agricultural seeds by pupils. Parts of the seed. (Use hand lens.) Seed planting by pupils in flats, the greenhouse, or out-of-doors. Agricultural seeds used. Germination studies, observation, drawings, recording conclusions from observations, etc.

f. Fertilization of the flowers.
g. Fruit. (Distinction between botanist's and farmer's or gardener's understanding of the meaning of fruit.)

Elementary study of the cell taken up with root, stem, and leaf study.

After stem study a few lessons on forestry and forest woods may well be given.

Seed selection. Germination tests. Purity tests.

Testing food seeds for starch, protein, sugars, fats, etc. Seed-planting machinery. Trip to implement houses for inspection of seed-planting machines. Observation in field, if possible.

Seed dispersal. Examination of different kinds of seeds. Field trip.

Roots. Field trip for observation of root systems of agricultural plants, uses of roots, kinds of roots, etc. Laboratory study of root hairs, root cap, etc., with hand lens, and possibly with the compound microscope. Root structure. Experiment to determine the point of growth of roots.

Stems. Field trip for observation of different kinds of stems, forms of stem growth, etc. Laboratory examination of stems. Study of the cornstalk

(monocotyledon), and the circulation of food and water in such a stem. Examination of typical dicotyledonous stem (agricultural). Structure. Circulation of food and water. Uses of stems. If forestry is taken up, examine woods commonly used in building, etc.

The leaf. Observation of parts of the leaf, veining, kinds, arrangement, etc.

Experiments to show transpiration. Demonstrations by the instructor as to nature and characteristics of carbon dioxide, composition of starch, etc.

Experiments by pupils: detection of starch in leaves, effect of light on starch manufacture, etc.

Flowers. Laboratory study of parts. Examination of different kinds of agricultural and other flowers, relation of form to fertilization, etc.

Observation of bees. Relation of bees and other insects to

		the fertilization of flowers. (Observation hive in the laboratory.) Fruits. Examination of typical agricultural fruits.
3. Physiology. *a.* The activities of the plant. *b.* The growth of the plant. *c.* Propagation by seeds. *d.* Propagation by buds. *e.* Propagation by cuttings (leaf, stem, roots, etc.). *f.* Propagation by layering. *g.* Propagation by bulbs. *h.* Propagation by roots. *i.* Propagation by stolons and suckers. *j.* Propagation by spores.	3. Botany. Movement of plant juices. Joint action of chemical and physical agents. Biology. Comparison of plant and animal physiology. Botany. Chemistry. Oxidation involved in germination. The universality of this kind of chemical change in animals and plants while they are in an active condition. Change of starch to soluble forms, fats to starch, insoluble to soluble proteids. Spore-plants.	3. Demonstrations by the instructor to illustrate various scientific facts and principles noted in column 2, under division 3. Greenhouse work by pupils, in plant propagation by stolons and suckers, layering, budding, etc. Seeding experiments, depth to plant seeds, preparation of the seed-bed, care after planting. Development of molds from spores. Growing mushrooms. Individual garden work may also be started here if desired and if the climate permit. It may, however, very well be started at any other point in the course if it proves more convenient.

4. Heredity. *a.* Principles of heredity. *b.* Steps in plant improvement. Methods of plant improvement. (1) Variation. Environment. Crossing. (2) Selection. (3) Fixing the desired variations. *c.* Examples of improvement in plants. Typical illustrations.	4. Biology. Organic evolution. Theory of descent. Facts from the records of the rocks. Factors in organic evolution. Natural selection. Artificial selection. Isolation. Theories of De Vries, Mendel, etc. Work of Burbank and others.	4. Field studies of variation in hills of potatoes, wheat plants, corn plants, etc. Field trip for observation of evidences of the struggle for existence in weed patches and in forest growths. Pruned and unpruned trees. Measuring of 100 stalks of wheat or other grain, and illustration of Galton's law by drawing on coördinate paper. Studies of the struggle for existence among cultivated plants. (Sow a row of radishes or lettuce thickly. Thin one-half the row; leave the rest to grow as best it can.) Struggle for existence among the eyes of a potato. Experiments and observations to show variation in plants induced by pruning, differences in food supply, etc. Hybridization. Cross fertilization of selected plants on the school grounds by students. Experiments in the improvement of wild and other plants.

5. Environment. Light and heat. *a.* Relative interdependence of light and heat. *b.* Effect on plant growth of light and heat. *c.* Influence of the character of light on plant growth. *d.* Influence of seasons. *e.* Temperature for germination and growth. *f.* How effect of light and heat may be modified. (1) Color. (2) Evaporation. (3) Topography. (4) Character of the soil. (5) Cultivation. (6) Drainage. (7) Thickness of planting. (8) Artificial methods. Screens. Artificial heat. Electricity. (Modification of light and heat by evaporation, cultivation, character of the soil, and drainage should be merely touched upon	5. Physics. Elementary study of light and heat. The thermometer. Elementary study of color. Physical geography. Control of geographical distribution of plants by temperature. Distribution of temperature. Heat zones and belts.	5. Laboratory demonstrations and exercises to show the transmission of heat by conduction; to show convection and to illustrate transmission of heat by convection; to show the production of heat by chemical action, by impact, etc. Experiments to show the effect of different temperatures on plant growth. Laboratory demonstrations and exercises to show refraction of light rays; dispersion of light rays; the composing of white light from the prismatic colors; etc. Experiments to show variation in plants due to different exposures to light. Experiment to show the effect of different colored lights on plant growth.

here, as they will be taken up more fully later under the special topics of the soil, drainage, etc.)		
6. Environment. Air. Moisture. *a.* Why each is necessary to plant life and growth. Importance to plants. *b.* Quantity of moisture required.	6. Physiography. The atmosphere. Composition and characteristics of air. Physics. Mechanics of gases. The barometer. Physiography. Movements of air, work of winds. Storms. Weather maps, prediction of weather. Moisture in the air. Evaporation, condensation, etc. Snow, rain, etc. Climate.	6. Laboratory demonstrations of the preparation and properties of oxygen, hydrogen, nitrogen, carbon dioxide, etc. (Partly as a review.) Demonstration by instructor and experiments by pupils to show that air exerts pressure. Making of a barometer. Demonstrations and experiments to show that air has weight. Practice in the use of weather maps. Experiments to show the necessity of air for plant life and development. Demonstrations or exercises to show evaporation and condensation, to determine the dew-point, relative and absolute humidity, etc.

7. Environment. The soil. *a.* Function of soil. *b.* Soil formation. *c.* Kinds of soil. *d.* Properties of soil. *e.* Soil organisms (treated in greater detail under nitrogen). *f.* Soil moisture. (1) Kinds. (2) Sources. (3) Functions. (4) Amount required for crops. (5) Modification of soil moisture by the kind of soil, topography of the land, by fertilizers and lime, by cultivation, and by drainage and irrigation. *g.* Soil air. (1) Functions of air in soils. (Oxygen, nitrogen, etc.) (2) Soil ventilation. By diffusion. By expansion and	7. Agricultural geology. Physical geography. Formation of soils. Biology. The part of plant and animal life in soil formation. The earthworm and its work. Erosion, weathering, etc. Agricultural physics. Physical properties of soils. Chemistry. Elements present in soils. Physics. Mechanics of liquids, capillarity, surface tension. Mechanics of gases. Soil fertility. How a soil analysis is made; value of soil analysis. Available and unavailable plant food. Physics. Mechanical principles. The lever, friction, etc. (Tillage and tillage implements.)	7. Field trip to note evidences of soil formation. Demonstrations to show expansion by heat and contraction by cooling, etc. Exercises to show action of heat and cold, of acid on rocks; of frost on soils. Observation and study of the earthworm and its work. Examination of typical soils in the field and laboratory. Exercises to illustrate acids and alkalis. Collection of soil samples. Experiments to show the effect of moisture upon soil temperature. Exercises to show porosity of soils, the capacity of soils to take in rainfall, hydroscopic moisture in soils, etc. Exercises to illustrate soil capillarity, evaporation of moisture from the soil under different conditions, etc. Exercises to show the importance of water to plants.

compression of air due to barometric pressure.

By expansion and contraction of air due to temperature.

By the suctional effect of wind.

Air absorbed by rain water.

By removal of water through drainage, evaporation, and transpiration of plants.

(3) Modification of soil ventilation.

What a farmer may do to assist in soil ventilation. (Taken up in greater detail under drainage, tillage, and crop rotation.)

k. Soil as a source of plant food.

(1) Importance as compared with other sources.

Agricultural physics. Mechanics of liquids. (Drainage and irrigation.)

Exercises to prove that there is air in soils; to show the per cent of air space in the different soils.

Exercise to illustrate tillage of light and heavy soils. (Large pots may be used for this laboratory exercise.)

Exercise to show the effect of tilth upon the temperature of the soil; to show the effect of smoothness of surface upon soil temperature; to show the effect of a mulch upon the loss of water from soils by evaporation; to show the effect of different kinds of mulches, relative effectiveness of artificial mulches of different materials; the depth of cultivation which shows the best results in the conservation of moisture. Trip to implement house to observe and to study the various tillage implements; plows, cultivators, harrows, etc. Trip to implement house to ob-

(2) Modified by — Kinds of soil (soil types). Topography. Tillage. Drainage. Irrigation. Fertilizers. Systems of cropping. *i.* Tillage of the soil. (1) Purposes and effects. (2) Methods. (3) Implements and tools used. *j.* Drainage. (1) When needed. (2) Purposes and effects. (3) Methods. (4) Drainage tools and materials. *k.* Irrigation. (1) When needed. (2) Purposes and effects. (3) Methods. Tools.		serve and become familiar with drainage tools. Exercises to illustrate drainage. Field trips, if they can be arranged, to farms where drainage systems are being laid out. Field trips to visit farms where land is being prepared for irrigation. Observation as to tools and methods used in laying out ditches, preparation of land for different methods of applying water, etc. Exercises to illustrate irrigation. Exercises to illustrate the effect of irrigation upon alkali soils.
8. The plant environment. Plant food. *a.* Elements needed. (1) Function. (General.)	8. Chemistry. Review elements necessary for plant life. Biology. Nitrogen-fixing bacteria, etc.	8. Pot culture studies of different plant foods (adding lime, potassium, chloride, sodium nitrate, etc., to pots of pure

(2) Sources.
- (*a*) Air.
- (*b*) Soils.
- (*c*) Fertilizers.
  - 1′. Classed according to constituents.
    - *a*′. Nitrogen.
      - Source.
      - Function.
      - Amounts needed by plants.
      - Fixation of free nitrogen.
        - With certain plants.
        - Without plants.
        - Organisms.
        - Cause of tubercles.
        - Effects of organisms.
        - Influence of conditions.
      - Nitrification.
      - Denitrification.
      - Loss through drainage.
    - *b*′. Phosphorus.
      - Source.
      - Function.
      - Amounts needed.
    - *c*′. Potash.
      - Source.
      - Function.
      - Amounts needed.
    - *d*′. Other amendments; lime, etc.

sand in which wheat is sowed and grown). Pot culture tests to note differences in fertility of different soils. Examination of alfalfa plant or other legume showing nodules of nitrogen-fixing bacteria.

Study of fertilizer samples.

Exercises to note solubility of different commercial fertilizers.

Field plot tests of different kinds of fertilizers.

Mixing of commercial fertilizer ingredients to make a complete fertilizer.

Study of losses of manure exposed to weathering, etc.

Exercises to show the effect of plowing under manures and clods.

2′. Classed according to form. a′. Farm manures. Kinds. Animal manures. Green manures. Properties, sources, and uses. Preparation, care, and handling. Application, — time, and amount to apply. Economy. b′. Commercial fertilizers. Sources. Uses. Applications. Economy. 3′. Economy.		
9. Repressive agencies. a. Insects and other animals. b. Diseases. c. Weeds. d. Unfavorable weather. e. Acidity and alkalinity of soils. f. Toxic agencies.	9. Biology. Parasitism. Entomology. Life history of injurious insects, their structure and development. Bacteriology. Plant diseases. Fungi. Biology. Organic evolution, plant competition, the struggle for existence. Physiography. Climate as related to agriculture. Winds, course of storms, etc.	9. Collecting of various insects of special interest agriculturally. Observation in vivaria. Field trips for observation of different kinds of scale. Collection of certain kinds of caterpillars and observation in a vivarium to note changes. Collection of cocoons. Bring into schoolroom to see moths emerge.

	Chemistry. Acids. Alkalis. Neutralizing agents.	If possible, trip to observe treatment for scale, or spraying of trees or plants by pupils to prevent insect injuries. Field trip for observation of smuts, rusts, and other plant diseases. Field trip, collecting and making list of common weeds of the locality. Observation and notes as to character of seed, method of dispersal, the weed roots, how the weed spreads, how it injures crops, etc. Note weeds especially associated with different farm crops. Test soils for acidity and alkalinity if this has not been done while studying soils.
10. Rotation of crops. *a.* Principles. *b.* Systems.		
11. Classification of economic plants. *a.* Cereals. *b.* Grasses. *c.* Legumes.	11. Economic botany. Uses of different crops or plants to man.	11. Field and laboratory study of different crops. Observation of cultural methods, examination and judging of products.

d. Vegetables.
e. Fruits.
f. Tubers.
g. Roots.
h. Sugar plants.
i. Oil plants.
j. Fiber plants.
k. Stimulants.
l. Medicinal and aromatic plants.

(Study of the culture, harvesting, uses, etc., of typical local crops, — a cereal, a legume, a grass, etc.)

field, and class work as seems best, but one-third of the time at least should be given to laboratory work. Demonstrations by the instructor, field trips, garden or greenhouse work and school farm practicums will consume nearly another third of the time, leaving not over a third of the class periods for recitations and lectures. Reading or other assignments should, however, be made regularly for laboratory as well as for the regular recitation days.

As a general rule it is suggested that demonstrations, laboratory, or field work precede the study of the reading assignment, though in special cases the order may be reversed. Careful written or printed directions for all laboratory and field work should be given students, and each student should keep a notebook in which every laboratory and field exercise and demonstration is carefully recorded in good English. This notebook should contain the date and subject of each exercise, a statement of the materials used, descriptions of the work done, and such illustrative drawings as may be necessary. In preparing an index to this notebook the student should specify whether the work is a laboratory exercise, a field exercise, or a demonstration made by the teacher or another student.

The value of demonstrations by the teacher or by individual students before the class should not be underrated, though such work should not, of course, be carried

to excess. Frequently the demonstration avoids both loss of interest and loss of time, besides facilitating the making of drawings and notes.

The laboratory or field exercises may be followed by assigned readings on the topics being studied and, later, by a recitation where the whole topic is reviewed and discussed with reference to its bearing on the home life of pupils, the general community life, and the practice of agriculture.

The excursion or field trip should not be neglected in this first year agricultural work, for it serves as a valuable means of bringing principle and theory in contact with real conditions and of dealing with processes and products at first hand. On the field trip or excursion many points difficult to explain and to understand in the classroom are made clear and vivid. New light is thrown on subjects studied, and desired information is fixed in memory.

All excursions should be carefully planned by the instructor, and students should be given definite directions as to procedure and observations on the trip. If possible, it will be found well to utilize a camera on such trips, recording in pictures the conditions at places visited. The pictures may later be used in reviewing the trip or be added to a permanent collection for reference or illustration.

Garden work may, if desired, be carried on very suc-

cessfully in connection with the first year agricultural work in addition to the regular practical exercises of the course in the greenhouse and on the school farm. If such work is undertaken, considerable latitude may well be allowed pupils in the choice of crops to be grown. Individual plots should be assigned the members of the class, each plot or garden serving as a special problem for the individual student. Or, if desired, the same crops may be grown by all members of the class; for example, vegetables, and in addition some special problem or additional crop may be given each student. This special problem may deal with the use of cold frames, hot beds, the use of fertilizers, or the testing of different methods of planting or of caring for plants. In many cases it may be well to have this special problem work carried on at home, or even to allow the garden work as a whole to be carried on at home.

In the garden students should be expected to apply the knowledge gained in the classroom, and the results attained should be looked upon more or less in the light of a test as to the ability of students. The time given to garden work should come outside of the regular class periods, as a rule, just as does the study of reading assignments, except where the work done is to teach a new fact or method, and not merely to give practice in carrying on garden work. Both the amount and times of work in the garden may be left largely to students, thus develop-

ing a sense of personal responsibility and self-reliance, training reason and judgment, and increasing the value of the work as a test. There should, however, be frequent inspection of gardens by the instructor, occasional class talks about the garden work, and judicious individual criticism and advice where needed.

The products of the gardens may be disposed of in various ways. If vegetables are raised, they may be donated to the domestic science department of the school and used by the cooking classes, thus correlating the agricultural and domestic science work. Or the vegetables may be donated to the pupil's family. If the school has an agricultural club, the vegetables may be marketed by a committee of the club or of the class and the proceeds turned over to the club, after deducting the expense of seeds, etc. In some cases a stall has been rented at the town's public market, and the products of the school garden have been sold there. Still other excellent plans will suggest themselves to suit special conditions and the products grown. But on no account should the disposal of products be neglected and waste permitted.

On a part of the agricultural grounds of the school should be demonstration plots devoted to the growing of desirable introductions of farm crops new to the locality and to new varieties of common crops. Rotation and fertilizer demonstration plots should also be given a place on the school farm, illustrating the needs of the

THREE SYSTEMS OF IRRIGATION ILLUSTRATED IN THE SCHOOL GARDEN, HANFORD (CAL.) HIGH SCHOOL.

soil and of different crops, the effect of different kinds of fertilizers on plant growth and yields, the effect of food supply on variation and heredity, etc. These demonstration grounds will prove valuable in illustrating the work of the first as well as of other years, and all students should have an opportunity to do more or less work on the grounds and to become familiar with them, though their main care will devolve upon the person in charge of the work of the school farm.

In addition, a part of the agricultural grounds may profitably be given to a field museum, or crop garden, where as many as possible of the chief species of agricultural crops of the state are grown in plots arranged according to their family relationships, as, the leguminosæ, the graminæ, solanaceæ, etc. This crop garden will doubtless be as much used by the botany class as by the agricultural class, but will be very valuable to both. If possible, wild forms of plants from which cultivated crops have been developed should also be illustrated in the crop garden.

The equipment for the course must necessarily include many of the materials and some of the apparatus of the biology, botany, chemistry, physics, and other science departments of the high school, together with some special agricultural equipment. If the science and agricultural teachers are willing to coöperate, the added expense of the course will, however, be comparatively

small. The same microscopes may serve the biology and the agricultural courses; many of the same specimens may serve both for biology and agriculture and for geology and agriculture; much of the same apparatus may serve both chemistry and agriculture and physics and agriculture.

A greenhouse, or, in some climates, both a greenhouse and a lath-house, will be needed for the plant propagation and other work. These will also be used for the horticultural classes, however, and their cost should not be charged to the equipment for the first year agriculture class alone.

Samples of fertilizers will probably be gladly donated to the school by fertilizer manufacturers, though it will of course be necessary to purchase fertilizers for garden tests, etc. Soil samples, seed samples, and many of the needed materials for laboratory work may be collected by the students.

Tools for gardening will need to be purchased, but these will also be used by other agricultural classes. It will be necessary to purchase some little special agricultural equipment, as that for soil study. Most of the other apparatus and materials of the course will be found in any high school well equipped for science work. After once starting the agricultural work in a school, valuable collections of illustrative specimens of seeds, soils, etc., may soon be gathered and will form a valuable part of the equipment.

In addition, it must not be forgotten that in this as in other high school agricultural courses, the community contains much illustrative material which should not be neglected in instruction. When studying seeding and tillage, the farm implement houses should be visited. When studying plant propagation, visits should be made to local nurseries. Valuable material for studying plant heredity and plant improvement may be found on many farms and in many gardens. Drainage, irrigation, soil formation, soil types, plant diseases, the study of special crops, — all offer inviting opportunities for valuable field trips and observations in the community surrounding the school.

The library equipment for the first year agricultural work should include a wide range of books and bulletins. Fortunately, there is a wealth of material, much of which can be had for the asking. The teacher should select and secure from the lists of publications of the United States Department of Agriculture and the State Experiment Stations such bulletins and circulars as promise to be most helpful in the work of the course. Those suited to the comprehension of high school pupils should be given the preference, though more technical publications will also be needed for the use of the teacher.

Among books there may well be included at least two or three of the best high school botanies, physics, chemistries, biologies, physical geographies, and geologies;

the best of the elementary and secondary agriculture texts dealing with plant life and environment and farm crops; and a few standard agricultural books dealing with the topics of the course, as fertilizers, irrigation, drainage, farm crops, soils, plant diseases, and economic insects, together with the standard Cyclopedia of American Agriculture.

In addition, the teacher will find it most helpful to secure from the Office of Experiment Stations, from extension and agricultural education departments of colleges, from normal schools, state boards of agriculture, and state boards of education, as many as possible of the various publications giving illustrative lessons or laboratory exercises in agriculture. Though none of these publications contains as large or as varied a number of exercises as will be needed, yet the teacher will find valuable suggestions in many of them.

It is impossible to give a list of library equipment which will prove ideal for the first year agricultural course under all conditions. The following list of publications giving illustrative lessons and practicums will, however, be found useful; as will also the list of books, many of which should, together with two or three good texts each of botany, biology, physics, chemistry, physiography, and geology, be secured. Many others not on the list would also prove very helpful. No list of informational bulletins and circulars of the experiment

stations and the government on the topics of the course is given, as such a list can readily be made out by any teacher who secures their lists of publications.

Publications giving Illustrative Lessons, Laboratory Exercises, and Field Practicums, Many of which are adapted to the First Year Agricultural Work in the High School. (Many other useful exercises will be found in science and agricultural textbooks.)

Cornell Nature Study Leaflets. Published in several different series and with varying titles by the New York State College of Agriculture of Cornell University.

Course in Agriculture for High Schools and Academies in Maine. Prepared by Dean Wm. Hurd, College of Agriculture, University of Maine, for the State Superintendent of Schools. 1909.

Course in Agriculture for the High Schools of Michigan. Michigan Agricultural College, Department of Agricultural Education Bul. No. 1, 1910; No. 7, 1911.

Elementary Course in Horticulture for the Schools of Michigan. S. W. Fletcher. Published by the State Superintendent of Public Instruction as Bul. 28. 1908.

Elementary Laboratory Study in Crops for the Schools of Michigan. J. A. Jeffery. Published by the State Superintendent of Public Instruction as Bul. 26. 1907.

Elementary Laboratory Study in Soils for the Schools of Michigan. Published by the State Superintendent of Public Instruction. 1908.

Elements of Agriculture for Public Schools. Missouri State Board of Agriculture, Monthly bulletin, v. 4, No. 5. 1904.

Elements of Physical Science as Applied in Home, School and Farm Life. F. D. Barber. Published by the Illinois State Normal School, Normal, Illinois.

Exercises in Elementary Agriculture, — Plant Production. Office of Experiment Stations Bul. 186. 1907.

Exercises in Elementary Agriculture for Rural Schools. Prepared for the Maine State Education Department by J. E. McClintock and E. D. Ward, of the College of Agriculture of the University of Maine. 1910.

Experimental Studies of Plant Growth. B. M. Davis. Teachers' Bul. No. 2, Ohio State Normal College. (Oxford, Ohio.) Miami Bul., Ser. 7, No. 1. 1908.

Experiments with Plants and Soils. F. E. Edwards. University of California Cir. 58. 1910.

Forestry in Nature Study. Farmers' Bul. 468. 1911.

Laboratory Exercises in Secondary School Agriculture. Maine State Department of Education. 1912.

Manual of Agriculture for the Public Schools of Vermont. State Department of Education. 1911.

Normal School Instruction in Agriculture. Office of Experiment Stations Cir. 90. 1909.

One Hundred Experiments in Elementary Agriculture for California Schools. R. O. Johnson. Published by the State Normal School, Chico, California. 1908.

Potato Studies for Schools. J. W. Hungate. State Normal School, Cheney, Washington. Department of Agriculture Bul. A, No. 2. 1912.

Practical Exercises in Agriculture for Public Schools. Purdue University, School of Agriculture. 1904.

Principles of Plant Production. University of Missouri Public School Bul. No. 2. 1906. (Circular of Information No. 15 rev.)

Propagation of Plants. Farmers' Bul. 157. 1907.

Public School Agriculture. Massachusetts Agricultural College, Department of Agricultural Education. 1909.

School Exercises in Plant Production. Farmers' Bul. 408. 1910.

School Garden, The. Farmers' Bul. 218. 1909.

School Lessons on Corn. Farmers' Bul. 409. 1910.

Secondary Course in Agronomy. Office of Experiment Stations Cir. 77. 1908.

Seeds and Seedlings. New Hampshire College of Agriculture and Mechanic Arts School Bul. No. 3. 1908.

Seed Testing. New Hampshire College of Agriculture and Mechanic Arts School Bul. No. 4. 1908.

Simple Exercises Illustrating Some Applications of Chemistry to Agriculture. Office of Experiment Stations Bul. 195. 1908.

Soil. University of Missouri Rural Education Series Bul., v. 10, No. 10. 1909.

Soil and Its Relation to Plants. B. M. Davis. Teachers' Bul. No. 1, Ohio State Normal College. (Oxford, Ohio.) Miami Bul., Ser. 6, No. 3. 1907.

Soil Primer. Kansas State Agricultural College. "Agricultural Education," v. 3, No. 12.

Soil Studies. New Hampshire College of Agriculture and Mechanic Arts School Bul. No. 2. 1908.

Soils. Hampton (Va.) Leaflet. v. 4, No. 8. 1908.

Studies of Corn and its Uses. University of Illinois Agricultural College Extension Bul. 1908.

Syllabus for Agriculture in Secondary Schools. New York State Education Department. 1910.

Ten Lessons on the Study of Indian Corn. University of Missouri. 1909.

Tree Growing in the Public Schools. E. B. Babcock. University of California Cir. 59. 1911.

Use of the Score Card. Missouri State Normal School (Cape Girardeau, Mo.) Bul., v. 2, No. 2. 1910.

Use of Illustrative Material in Teaching Agriculture. U. S. Department of Agriculture Yearbook. 1905. pp. 257–274.

Year of Agriculture in a Rural Vermont High School. H. A. Farrar. Middlebury College (Middlebury, Vt.) Bul., v. 5. No. 5. 1911.

GOOD BOOKS FOR THE FIRST YEAR AGRICULTURAL REFERENCE COLLECTION. (Good high school texts in botany, chemistry, etc., should also be included in this collection, as mentioned above.)

BAILEY, L. H., ed. Cyclopedia of American Agriculture. 4 v. N. Y. Macm. 1907–1909.

BAILEY, L. H. Lessons with plants. N. Y. Macm. 1906.

BAILEY, L. H. Manual of Gardening. N. Y. Macm. 1910.

BAILEY, L. H. Plant Breeding. N. Y. Macm. 1910.

BAILEY, L. H. Principles of Agriculture. N. Y. Macm. 1909.

BARTO, D. O. Manual of Agriculture. Bost. D. C. Heath & Co. 1910.

BROOKS, W. P. Agriculture. 3 v. Springfield, Mass. Home Corresp. School. 1905.

BURKETT, C. W. Soils. N. Y. Orange Judd. 1911.

CALL, L. E., and SCHAFER, E. G. Laboratory Manual of Agriculture. N. Y. Macm. 1912.

CLUTE, W. N. Agronomy: a course in practical gardening for high schools. Bost. Ginn & Co. 1913.

COLEMAN, J. B., and ADDYMAN, F. T. Practical Agricultural Chemistry. N. Y. Longmans, Green, & Co. 1910.

COMSTOCK, J. H. Insect Life. N. Y. D. Appleton & Co. 1901.

DAVENPORT, E. Domesticated Plants and Animals. Bost. Ginn & Co. 1910.

DAVIS, C. W. Rural School Agriculture. N. Y. Orange Judd. 1911.

ELLIFF, J. D. A Unit in Agriculture. Chic. Row, Peterson & Co. 1911.

ELLIOT, C. G. Practical Farm Drainage. N. Y. John Wiley & Sons. 1908.

GOODRICH, C. L. First Book of Farming. N. Y. Doubleday, Page & Co. 1910.

HALLIGAN, J. E. Fundamentals of Agriculture. Bost. D. C. Heath & Co. 1911.

HILGARD, E. W. Soils. N. Y. Macm. 1906.

HILGARD, E. W., and OSTERHOUT, W. J. Agriculture for Schools of the Pacific Slope. (Accompanied by Babcock and Stebbins' Elementary School Agriculture; a manual of exercises. 1911.) N. Y. Macm. 1910.

HOPKINS, C. G. Soil Fertility and Permanent Agriculture. Bost. Ginn & Co. 1910.

HUNT, T. F. Cereals in America. N. Y. Orange Judd. 1911.

HUNT, T. F. Forage and Fiber Crops in America. N. Y. Orange Judd. 1911.

JACKSON, C. R., and DAUGHERTY, L. S. Agriculture through the Laboratory and School Garden. N. Y. Orange Judd. 1911.

KING, F. H. The Soil. N. Y. Macm. 1911.

KING, F. H. Physics of Agriculture. Madison, Wis. F. H. King. 1904.

KING, F. H. Irrigation and Drainage. N. Y. Macm. 1909.

LASSAR-COHN. Chemistry in Daily Life. Phil. J. B. Lippincott. 1909.

LYON, T. L., and FIPPIN, E. O. Principles of Soil Management. N. Y. Macm. 1911.

LYON, T. L., and MONTGOMERY, E. G. Examining and Grading Grains. Bost. Ginn & Co. 1907.

MANN, A. R. Beginnings of Agriculture. N. Y. Macm. 1911.

NOLAN, A. W. One Hundred Lessons in Agriculture. Chic. Row, Peterson & Co. 1911.

OSTERHOUT, W. J. V. Experiments with Plants. N. Y. Macm. 1911.

ROBERTS, I. P. Fertility of the Land. N. Y. Macm. 1909.

ROTH, F. R. First Book of Forestry. Bost. Ginn & Co. 1902.

SANDERSON, E. D. Elementary Entomology. N. Y. John Wiley & Sons. 1912.

SANDERSON, E. D. Insect Pests of Farm, Garden, and Orchard. N. Y. John Wiley & Sons. 1912.

Stevens, F. L., and Hall, J. G. Diseases of Economic Plants. N. Y. Macm. 1910.

Snyder, H. Chemistry of Plant and Animal Life. N. Y. Macm. 1905.

Snyder, H. Soils and Fertilizers. N. Y. Macm. 1908.

Vivian, A. First Principles of Soil Fertility. N. Y. Orange Judd. 1912.

Voorhees, E. B. Fertilizers. N. Y. Macm. 1910.

Warren, G. F. Elements of Agriculture. N. Y. Macm. 1910.

Weed, C. M. Farm Friends and Farm Foes. Bost. D. C. Heath & Co. 1910.

Wilkinson, J. W. Practical Agriculture. N.Y. Am. Bk. Co. 1909.

Wilson, A. D., and Warburton, C. W. Field Crops. St. Paul, Minn. Webb Pub. Co. 1912.

PRACTICUM

Outline not less than ten consecutive agricultural general science lessons covering some one phase of the first year work as outlined in the preceding chapter. Suggest laboratory or field practicums and reading references to accompany these lessons.

REFERENCES FOR COLLATERAL READING

Bricker, G. A. Teaching of Agriculture in the High School. Chapter 4. N. Y. Macmillan. 1911.

Editorial, Experiment Station Record, September, 1910, pp. 201–209.

Peet, C. E. What Shall the First Year High School Science Be? National Education Association, Proceedings, 1909, pp. 809–16.

Busy Bees at the Brawley (Cal.) High School.

CHAPTER VII

ANIMAL HUSBANDRY IN THE HIGH SCHOOL; THE GENERAL LIVE STOCK COURSE

THE nomenclature and character of animal husbandry courses in high schools vary greatly. As a rule, but one course is given during the four years, and this is general in nature, including some study of types and breeds, stock judging, feeds and feeding, care and management, dairying, etc. It is taught under such names as breeds of live stock, animal husbandry, animal production, domestic animals, animal industry, farm animals, agriculture, economic zoölogy, and others. When the animal husbandry work is divided into two or more courses in the high school, there is usually a general course in live stock study and, in addition, a course in dairying or in poultry culture, or both. We also occasionally find special courses in stock judging, stock feeding, breeding, apiculture, and other animal husbandry subjects. These last, however, are usually introduced to suit local conditions and needs, and we shall not consider them here. The courses in dairying, poultry culture, and animal production or general live stock are so frequently given

and of such universal interest that they may well be considered in some detail.

The name animal production, or animal husbandry, should preferably be chosen for a general course including a study of types and breeds and the care and management of domestic animals. Such a course may usually best be placed in the second year of the high school (see Chapter III), though it is frequently given during the third year. If this is the only animal husbandry course given, it should preferably run throughout the school year; but if a special course such as that in dairying or poultry work is given, the general course may be limited to the first half year and a special course be given during the second half. Or in some cases where a special live stock course is given in addition to the general course, it may seem desirable to give the general course three periods per week throughout the year and the special course two days per week, alternating. This arrangement has special advantages in the case of poultry work, particularly if poultry is kept on the school grounds. Students thus have the advantage of studying and of practicing the care and management of poultry at all times of the year and under many different conditions.

Another possible arrangement is having a dairy course in the first half of the year, followed by the general course in animal production the second half. The object of this is to begin with the study of products rather than of their

producers, with the more rather than the less familiar, and to emphasize the economic factor at the beginning of the animal husbandry studies.

The materials of the general course in live stock or animal production should consist of an introductory study of types and breeds of the common domestic animals followed by a study of their feeding and care, together with more or less consideration of their improvement or breeding. The emphasis laid upon the different phases of the work will, however, vary considerably in different localities, depending upon the main live stock interests of the surrounding country and the special needs of the community.

As in the case of agronomy or any other course, the instructor should prepare a careful outline of the work at the very beginning, emphasizing the study of the kinds of live stock in which the community is most interested. This need not be rigidly adhered to at all times, but should be so carefully prepared that it will seem wise to do so for the most part.

Various good outlines for the general animal production course in the high school have been prepared and printed. Some of the best of these are given at the end of this chapter. Suggestions may be obtained from all of them, though probably none of them is ideal.

The New York State outline (1907) emphasizes feeds and feeding, — the nutrition of domestic animals, — but

to their housing and care in other ways it gives practically no attention. The improvement of types and breeds is touched on, but very briefly. Animal products are studied, but no attention is given to their marketing.

The Michigan outline (1910) seems to emphasize the general care and improvement of live stock. Feeds are perhaps studied more from the practical and less from the scientific standpoint than would be the case were the New York outline followed.

The Office of Experiment Stations outline in Circular 60 (1904), for rural common schools, might well be adapted to high school use. It is, however, very brief and indicates a more elementary study of feeds and feeding than is desirable, besides omitting any study of live stock improvement or breeding. The preparation and care of products and their marketing is especially mentioned in the outline.

The Wisconsin outline (1911), intended to cover a year's work with one recitation per day, emphasizes stock judging and gives special attention to poultry. In addition, it gives a prominent place to the study of insects; but this is contrary to the general procedure and seems unwise in many ways. Their study under "repressive agencies" (p. 138) during the first high school year is undoubtedly preferable. Feeds and feeding are not included in the general live stock or animal husbandry course at all, but are studied in a course in agricultural

chemistry which is given during the fourth year of the high school. The study of dairy products, and their testing, is also put in the course in agricultural chemistry.

The outline by J. D. Elliff, of the University of Missouri, is intended only as an outline for a part of a year's work in general agriculture. It might, however, very well be used as a basis for a special animal husbandry course, if desired.

In January, 1911, the Office of Experiment Stations published a valuable circular, prepared by Professor H. R. Smith, head of the Animal Husbandry department of the University of Nebraska College of Agriculture, outlining a course in animal production. This circular is entitled "A Secondary Course in Animal Production," and in it are outlined 155 lessons which, with necessary reviews, examinations, and a few supplementary field trips or lessons of a purely local nature, will occupy a full school year of thirty-six weeks, five recitations per week. The course as outlined deals almost entirely with types and breeds and the feeding and care of farm animals, although some time at the close of the year is devoted to the special topic of dairying. In the introduction to the circular the author states that where it is undesirable to give a full year to the general course in animal production, it can be shortened by omitting certain of the less important lessons or by studying only the most general facts relating

to animals having small commercial value in the locality. Thus, for example, there are many localities where the two lessons on ponies, asses, and mules could be omitted, because these animals are there so seldom seen or used as to be of no economic importance. Again, there are regions where cattle raising runs almost entirely to one type, — either the beef type or the dairy type. In such places the emphasis should be placed on the important type of cattle, and only such time as can be spared should be given to the less important types. The same considerations should govern the study of sheep, swine, and other animals or topics included in the outline, where it is desired to devote only a part of the year to the course.

Very full outlines for a general course in animal husbandry and for special study of beef cattle and their products, swine, bees and the production of honey, are given in Minnesota Department of Public Instruction Bulletin 38, "Outlines for Secondary Courses in Agriculture." Suggestions as to materials, apparatus, and library equipment needed for the work accompany these outlines.

One forty- to fifty-minute period per day will ordinarily prove sufficient for the work,[1] though on one day per

[1] In a number of high schools, however, a daily double period is considered necessary for the work when only given during half of the year. Bakersfield, Cal., is an example. At the John Swaney School, McNabb, Ill., three double periods per week and two recitation periods are given to the work.

week this time should be extended to a double period for stock judging, field trips, and other practicums. If possible, the last period of the day should be used for the course, so that on days when excursions or field trips are taken, or stock judging or other practicum work is done, extra time can be taken if necessary without interfering with other recitations. And though one practicum day per week will usually give enough time for such work in either a year or half-year of animal husbandry, where the class meets five periods per week, yet it may be desirable when studying types and breeds to take occasional extra periods for stock judging,—or rather to use some of the regular recitation periods for extra practice in this work. It will probably also be desirable occasionally to take excursions or field trips on Saturdays, especially when trips are to farms at some distance or when it is desired to inspect stock at some particular time of day.

As a textbook to be used in the animal husbandry course, C. S. Plumb's "Beginnings in Animal Husbandry" and M. W. Harper's "Elements of Animal Husbandry" are both satisfactory. Plumb's "Types and Breeds of Farm Animals" and Harper's "Manual of Farm Animals" have been used, but are adapted to college rather than high school classes. But even though a textbook is used, it should be supplemented by lectures (see p. 74) and by reading assignments in bulletins and agricultural reference books.

As to the "laboratory manual," giving practical exercises in general live stock study, there is none for the animal husbandry course in the high school. Office of Experiment Stations Circular 100 suggests excellent practicums, but cannot be considered as a manual of live stock exercises. A large number of the exercises noted will undoubtedly be used, but definite directions for the work must be prepared for students in each case; and it will be desirable to have additional exercises to suit local needs. In addition, score cards should be provided for the stock judging work of the course. If possible, copies of Purdue University Agricultural Experiment Station Circular 29, "Stock Judging for Beginners," and of the Cape Girardeau, Missouri, State Normal School Bulletin on "The Use of the Score Card in Rural Schools," should be secured for each member of the class. A sufficient number of J. A. Craig's "Judging Livestock" should also be available for consultation by students.

Valuable hints as to practical exercises may also be found in such publications as the New York State Department of Education "Syllabus in Agriculture for Secondary Schools"; "Course in Agriculture for the High Schools of Maine," arranged under the direction of the State Superintendent of Public Instruction; Michigan Agricultural College Department of Agricultural Education Bulletins no. 1 and 7, "Course in Agriculture for the

High Schools of Michigan"; D. J. Crosby's "Use of Illustrative Material in teaching Agriculture in Rural Schools" (in the 1905 U. S. Department of Agriculture Yearbook); Purdue University School Bulletin giving "Practical Studies in Agriculture for the Common Schools"; and many others.

In addition, the practical exercises given in Elliff's "Unit in Agriculture" and at the end of chapters on live stock in Davenport's "Domestic Animals and Plants," Warren's "Elements of Agriculture," and in other good secondary and elementary agriculture texts should be noted.

In general, the practicums will consist of trips to see various kinds of stock at farms of the community, at the local fair, etc.; judging of individual animals owned in the vicinity; competitive judging, following considerable preliminary practice; trips to see buildings for the different farm animals, noting details of construction, stalls, yards, and other equipment; a trip to the nearest packing house center, if it can be arranged, for observation of methods of slaughtering animals, handling carcasses, and packing house by-products; trips to local markets to see the different cuts of meat; visiting dairies, creameries, and cheese factories. Practical work in the care and management of some farm animal or animals should also be included, where possible. This may be at the school if the school is equipped with

stock, or it may be at the homes of the community. Individual home experiments in the feeding and management of stock will prove of especial value to students, throwing them largely on their own responsibility and developing initiative, good judgment, and self-reliance. All such work should, however, be planned and carried out by students under the careful supervision of the instructor.

The recitation and review quiz in the animal husbandry course will be conducted as in other courses. The lecture will serve a purpose similar to that of the lecture in any other course, gathering up and presenting in suitable form material which it is desirable to give to students and which is not readily available to them in proper form in their text or reference books. A form of lecture which can be utilized with especial profit in this course is the lantern lecture, illustrating types and breeds, points in stock judging, conformation of animals, buildings for farm animals, etc. The lantern used should be one adapted to showing pictures in books and bulletins, as well as slides; for there is a great wealth of good illustrations in many of the animal husbandry publications which will doubtless be available for use.

Throughout the course the methods of instruction should take cognizance of the fact that animal husbandry, like other agricultural subjects, is both a science and an art; it deals both with a body of organized laws and

principles and with their application to actual problems. We must not only see to it that pupils acquire information from lectures and printed matter; they must be given constant opportunity for reference to the animals studied and for observation of the various phenomena concerning which information is sought and given. Pupils must be taken to the farm and farm animals for demonstration and proof of facts acquired in the schoolroom. Opportunity must also be given, as far as is practicable, for actual experience in the judging of live stock and in their care and management. The latter will, as has been indicated, probably have to consist of individual assignments to be carried out at home, and may vary widely in nature. But some first-hand experience and knowledge of farm animals, in the way of feeding or other experiments or practicums in their care or observation, should be acquired by every pupil. It not only emphasizes knowledge acquired in the classroom, but gives *ability to do*, — that is, to *use* the acquired information. And practice or repetition of this first-hand experience with animals gives to the pupil not only ability to do certain things, but facility, accuracy, and efficiency in his doing.

The equipment for the animal husbandry work must naturally vary greatly under different conditions. Much of the material used will be found on the farms of the community. In addition, there should be a school-

room so screened as to be easily and quickly darkened; a set of animal charts (which may be made in the art department of the school, copied from government bulletins); a supply of score cards for the various types of farm animals (which may be printed by the local printer); a good lantern with an abundant supply of animal slides; and if possible a few good animal models.[1]

It is, of course, taken for granted that any school giving a four year course in agriculture has some land available for agricultural purposes, and it is extremely desirable that the school own some live stock. The kind and amount will necessarily depend largely upon the resources of the school. (See Chapter XII, "The School Farm.") In any case it will, however, be necessary to draw largely upon the community for materials for observation and practicums for this course.

If no special dairy course is given at the school, some testing of milk and dairy products should be done in the general animal husbandry course. A Babcock tester, milk and cream bottles, Farrington test tablets, lactometers, etc., should therefore be available for use. If a special dairy course is given, such work may best be omitted from the general live stock course.

The agricultural library should of course be supplied

[1] Score cards, lantern slides, anatomical and veterinary charts, and models of certain farm animals may be obtained from the Central Scientific Co., Chic., Ill.

with an up-to-date collection of government and experiment station publications on live stock topics, selected from the lists issued by them. The school should take regularly one or more of the best live stock periodicals and the more important material of each number should be noted in the live stock class as soon as convenient after the number is received. In addition, there should be a good collection of books on live stock, adapted to the comprehension of high school pupils. If funds are available, any or all of the following list may well be included, after securing the indispensable Bailey's Cyclopedia, already listed with the books for first year agriculture.

BRIGHAM, A. A. Progressive Poultry Culture. Cedar Rapids, Ia. The Torch Press. 1908.

COBURN, F. D. Swine in America. N. Y. Orange Judd. 1909.

CRAIG, R. A. Diseases of Swine. N. Y. Orange Judd. 1906.

CRAIG, J. A. Judging Livestock. Ames, Ia. J. A. Craig. 1901.

DAVENPORT, E. Domesticated Animals and Plants. Bost. Ginn & Co. 1910.

FARRINGTON, E. H., and WOLL, F. W. Testing Milk and Its Products. Madison, Wis. Mendota Pub. Co. 1911.

HARPER, M. W. Elements of Animal Husbandry. N. Y. Macm. 1913.

HARPER, M. W. Manual of Farm Animals. N. Y. Macm. 1911.

HENRY, W. A. Feeds and Feeding. Madison, Wis. W. A. Henry. 1911.

JOHNSTONE, J. H. S. The Horse Book. Chic. Sanders. 1911.

JORDAN, W. H. Feeding of Animals. N. Y. Macm. 1911.

MAYO, N. S. Care of Animals. N. Y. Macm. 1903.

Mayo, N. S. Diseases of Animals. N. Y. Macm. 1910.
Plumb, C. S. Beginnings in Animal Husbandry. St. Paul, Minn. Webb Pub. Co. 1912.
Plumb, C. S. Types and Breeds of Farm Animals. Bost. Ginn & Co. 1906.
Reynolds, M. H. Veterinary Studies. N. Y. Macm. 1910.
Roberts, I. P. The Horse. N. Y. Macm. 1905.
Robinson, J. H. Poultry Craft. N. Y. Orange Judd. 1899.
Shaw, T. Animal Breeding. N. Y. Orange Judd. 1911.
Shaw, T. Feeding Farm Animals. N. Y. Orange Judd. 1907.
Shaw, T. Management and Feeding of Cattle. N. Y. Orange Judd. 1910.
Smith, H. R. Profitable Stock Feeding. Lincoln, Neb. H. R. Smith. 1906.
Wilcox, E. V. Farm Animals. N. Y. Doubleday, Page & Co. 1906.
Wing, J. E. Sheep Farming in America. Chic. Breeders' Gazette. 1912.

In addition to the school work in animal husbandry, the agricultural teacher will here find an excellent opportunity for community work. Evening lectures may be given on the improvement of live stock or other live stock topics of particular interest locally; lantern slides and pictures may be shown; boys' and girls' clubs may be organized for the raising of poultry, feeding experiments, etc.; short courses on the kind of live stock most raised in the community or in which there is the most interest, may be given; home experiments may be supervised; plans for buildings may be prepared; and so on. All such work will not only help the community but

will react to the benefit of the school and repay manyfold the effort exerted in carrying it on.

OUTLINES FOR ANIMAL PRODUCTION OR GENERAL LIVE STOCK COURSES

A

Animals and Animal Husbandry

(An outline taken from the New York State Department of Education Syllabus in Agriculture for Secondary Schools. 1907.)

A. The kinds of domesticated animals.

1. Classification of common domestic animals.
   Mammals: cattle, sheep, swine, horses, asses, mules, dogs.
   Birds: fowls, ducks, geese, pigeons, turkeys.
   Insects: bees.

2. Zoölogical relationships: origin, history of domestication, purposes for which kept, races, breeds, and varieties of each.

B. Nutrition of domestic animals.

1. Relations of plant and animal life.

2. The chemical elements of nutrients: their number and occurrence in plants and animals.

3. The compounds of animal nutrients.
   a. Water: in living plants, feeding stuffs, the animal. Its occurrence and functions.
   b. Mineral matters (ash) in the plant and in the animal: amount and distribution.
   c. The nutrients.

C. Nutrition (*continued*). The nutrients in detail.

1. Protein.
   - *a*. Nomenclature.
   - *b*. Examples.
   - *c*. Composition.
   - *d*. Physical characteristics.
   - *e*. Variability.
   - *f*. Occurrence.
   - *g*. Distribution.

2. Carbohydrates.
   - *a*. Examples.
   - *b*. Composition.
   - *c*. Physical characteristics.
   - *d*. Nitrogen — free extract and crude fiber.
   - *e*. Starches.
   - *f*. Sugars.
   - *g*. Occurrence and distribution.

3. Fats and oils.
   - *a*. Character and composition.
   - *b*. Occurrence and distribution.

4. Functions of the nutrients.
   - *a*. Protein.
   - *b*. Carbohydrates and fat.
   - *c*. Relations to one another.
   - *d*. Nutritive ratio.
   - *e*. Food as a source of energy.
   - *f*. Heat relations.

D. The digestion and utilization of food.

1. The digestive tract.
2. Ferments.

3. Conditions influencing digestion.
   a. Palatableness.
   b. Quantity.
   c. Stage of growth of plant.
   d. Effect of methods of preservation and storage.
   e. Grinding.
   f. Addition of salt.
   g. Frequency of feeding and watering.
   h. Determination of digestibility.
4. Distribution and use of digested food; also elimination of wastes.

E. Foods.

1. Pasturage.
2. Forage and fodders: green and dried fodders, soiling, silage.
3. Root and tubers.
4. Concentrated feeding stuffs: grains and seeds, commercial by-products.

F. Rations.

1. Food requirements of different animals for different purposes.
   a. For maintenance.
   b. For work.
   c. For growth (young animals).
   d. For flesh (fattening).
   e. For milk, eggs, wool, etc.
2. Combination of fodders into rations.
   a. Amount of nutrients.
   b. Amount of water (succulence).
   c. Relative proportions of protein and non-protein (nutritive ratio).

d. Palatableness.
e. Effect on product.
f. Economy.

G. Animal products.

1. Flesh: beef, mutton, pork, poultry; relation between the raising of different animals for various products; composition of animal products; quality as determined by age and condition of animals; relative suitability as food for man; economy.

2. Eggs: composition; quality as affected by food of fowls; methods of preservation; economy.

3. Milk.

a. Source; kind of animal; physiology of secretion; methods of milking.
b. Quality; chemical and physical properties; natural variations as affected by animal, by food, by environment, by adulteration.
c. Determination of specific gravity, fat, organisms, impurities, adulteration.

H. The animal. (The animal form as related to production.)

1. Animal mechanism in relation to speed and force, types of animals for production of milk and beef, wool and mutton, eggs, and flesh. Correspondence of individual to type. Standards or scales of points; methods of scoring.

2. Selection of animal with reference to future generations; heredity; variation; evolution of modern forms from simpler types.

B

Animal Husbandry or Live Stock

(From "A Course in Agriculture for the High Schools of Michigan," Michigan Agricultural College, Department of Agricultural Education Bul. 1, 1910.)

The part of this bulletin dealing with the animal husbandry course in the high school was prepared by Professor R. S. Shaw and Professor A. C. Anderson, and reads as given below.

- Animal husbandry or live stock.
  - Breeds.
    - Cattle.
    - Horses.
    - Sheep.
    - Swine.
  - Uses.
  - Care.
  - Feeding.
  - Breeding.
  - Judging.
  - Marketing.
- Poultry.
  - Breeds and breeding.
  - Incubators.
  - Care and feed.
  - Marketing.
- Dairying.
  - Care of milk.
  - Tests, Babcock, etc.
  - Testing individual cows.
  - Separators.
  - Butter making.
  - Cheese.

C

Animal Production

(Outline from Office of Experiment Stations Circular 60, "The Teaching of Agriculture in the Rural Common Schools." 1904.)

1. Domestic animals, their types and breeds.
   - Horses.
     - Draft.
     - Trotting.
     - Roadsters, etc.
   - Cattle.
     - Dairy.
     - Beef.

     Bring out leading characteristics of one or two leading breeds of each type represented in a given region.
   - Sheep.
     - Wool.
     - Mutton.
   - Swine.
   - Poultry.
   - Bees.
2. Care and management of domestic animals.
   - Feeding. Only the most general statements regarding the food requirements of different animals and for different purposes, and exercises in compounding rations suitable to a given region.
   - Hygiene.
     - Water supply.
     - Exercises.
     - Shade.
     - Conditions of inclosures as to (1) comfort, (2) ventilation, (3) cleanliness.
   - Preparation and care of product.
   - Marketing of product.

D

Animal Husbandry

(From University of Wisconsin Bul. No. 441, high school series No. 12, 1911. "The High School Course in Agriculture.")

Course given during the third year of high school agricultural work. Daily throughout the year.

1. Breeds of live stock.
   a. Principles of breeding.
   b. History of progress made in animal breeding.
   c. Standard breeds.
   d. Breed characteristics.

2. Stock judging.
   a. The "points" on the score card.
   b. Lantern slide demonstrations.
   c. Practice in judging stock easily available.
   d. Visits to best herds in the vicinity.

3. Poultry.
   a. Poultry as an economic factor in farm and city life.
   b. The care and management of poultry.
   c. Feeding poultry and marketing poultry products.
   d. Judging poultry.

4. Insects.
   a. Life history of insects.
   b. Collecting and preserving specimens.
   c. Insects injurious to our fruits and grains.
   d. Means of controlling ravages of insects.

Animal Husbandry — Details of Work

1. Types and breeds of live stock.

The work in this subject may well consist of a study of the history of the various breeds and classes of live stock, the methods

used to develop these breeds, the distinguishing characteristics of standard breeds and the special merits of each. This intensive study of animal life in the high school is confronted by special difficulties. If the school is equipped with pictures, charts, a well-chosen collection of animal slides and a good lantern, these difficulties may be largely overcome. (See Plumb's "Types and Breeds of Farm Animals.")

2. Stock judging.

The theoretical part of this work should be done in the classroom by the use of charts, lantern slides, and the score card. Practice may be obtained from the scoring of individual animals owned in the vicinity of the school or borrowed from more distant breeders. Competitive judging work can be done by occasional visits to the best herds and flocks in the neighborhood. (See Craig's "Stock Judging.")

3. Poultry.

The study of poultry may easily be made a part of the high school curriculum. The birds themselves may be brought into the classroom. Specimens of each of the leading varieties of chickens may usually be found within easy reach of the school. Poultry and its proper feeding, care, and management should be studied as an economic factor in city and rural life. Practice should be given in judging poultry by means of the score card. The best methods to be used in preparing poultry and its products for market should receive attention. (See Robinson's "Poultry Craft.")

4. Insects.

This work should begin with a study of the life history of a few of the common insects and should include practice in the collection, mounting, and preservation of specimens. Insects like the plum curculio and the codling moth, such as are injurious to our native fruits, should be studied, and those that cause serious damage to

farm crops should receive due attention. The laboratory work may well include the preparation and application of insecticides. Other means of controlling these pests should be studied. A school collection of injurious insects and examples of their destructive work should be made. (See Comstock's "Insect Life.")

E

ANIMAL PRODUCTION

(From Office of Experiment Stations Circular 100, "A Secondary Course in Animal Production." 1911.)

Types and breeds of farm animals.
- Horses.
- Cattle.
- Sheep and goats.
- Swine.
- Poultry.

Feeding and care of farm animals.
- Stock feeds.
- Horses.
- Dairy cattle.
- Beef cattle.
- Sheep.
- Swine.
- Poultry.

Dairying.

F

ANIMAL HUSBANDRY

(From J. D. Elliff, "A Unit in Agriculture." Chic. Row, Peterson and Co. 1911.)

I. The Horse.

1. Origin and brief history.

2. The two principal types.
   a. The speed type.
   b. The draft type.
3. Breeds of horses.
   a. Draft breeds — Percheron, Clydesdale, English Shire.
   b. Roadsters — American trotter, American saddle horse, English thoroughbred, Hackney French coach.
4. Care of horses.

II. Cattle.
1. Origin and brief history.
2. The two principal types.
   a. Dairy cattle.
   b. Beef cattle.
3. Breeds of cattle.
   a. Beef breeds — Shorthorn, Hereford, Polled Hereford, Aberdeen-Angus, Polled Durham, Galloway.
   b. Dairy breeds — Holstein-Friesian, Jersey, Guernsey, Ayrshire, Dutch Belted, Brown Swiss.
   c. Dual purpose breeds — Shorthorn (milking strains), Devon, Red Polled.
4. Cattle products — meat, milk, leather, glue, etc.

III. Sheep.
1 The two types.
   a. Wool-producing type.
   b. Mutton-producing type.
2. Principal breeds.
   a. Wool producing — American Merino, Delaine, and Rambouillet.
   b. Mutton producing — Shropshire, Southdown, and Cotswold.
3. Care of sheep.

IV. Swine.
1. A study of the following principal breeds: Poland-China,

Berkshire, Duroc-Jersey, Chester White, Hampshire, Tamworth, Large Yorkshire.

2. Care of swine.
3. Diseases of swine and how to control or prevent them.
   a. Hog cholera.
   b. Tuberculosis.

V. Poultry. Chickens.

1. The four principal types.
   a. Meat type.
   b. Egg type.
   c. General purpose type.
   d. Ornamental type.
2. Breeds.
   a. Meat type or Asiatic class — Brahma, Cochin, Langshan.
   b. Egg type or Mediterranean class — Leghorn, Minorca, Black Spanish.
   c. General purpose or American class — Plymouth Rock, Wyandotte, Rhode Island Red.
3. Care of poultry.
   a. Feeding chickens.
   b. The incubator.
   c. The chicken house.
4. Poultry and poultry products, their growing importance, value and use.

VI. Live stock judging.

1. Horse.
   a. Heavy horse.
   b. Light horse.
2. Cattle.
   a. Beef cattle.
   b. Dairy cattle.

3. Sheep.
   a. Mutton.
4. Swine.

VII. Feeding.

1. Composition of food plants: (*a*) water, (*b*) ash, (*c*) protein, (*d*) fats and carbohydrates.
2. Percentage of each in different plants.
3. Function of each constituent.
4. Composition of animal tissue. (Compare with animal food plants.)
5. Digestion and palatability of foods.
6. The balanced ration.

Improvement of Farm Animals

1. Determining what animals shall be grown on the farm.
2. Importance of selecting only the best breeds.
3. Economy in feeding — the balanced ration.
4. Study of comparative value of common foods at current prices.

G

Domestic Animals

(Outline from "Course in Agriculture for High Schools in Maine." 1909. pp. 18–19.)

1. Classification.
   a. Cattle.
      Dairy.
      Beef.
      Dual purpose.
   b. Sheep.
      Fine wool.
      Mutton.

c. Swine.
Fat hogs.
Bacon type.

d. Horses.
Saddle horses.
Roadsters.
Coach or carriage type.
Draft type.
Ponies.

2. Animal breeding.
a. History of breeds, their formation, etc.
(1) Demonstrate by use of stock in the neighborhood.
b. The fundamental laws of breeding.
(1) Heredity.
(2) Inbreeding — good and bad results.
(3) Prepotency.
Individual.
Breed — value to the stock breeder.
(4) Selection.
According to merit.
According to pedigree and relationship.
(5) Prenatal influence of sire. Of dam.
c. The value of pure-bred sires.
d. The up-grading of herds or flocks by the use of pure-bred sires upon the animals already on the farms in the neighborhood.
e. Stock scoring and judging. Principles and practice.
f. Methods of keeping breeding and performance records.
g. A study of pedigrees.

Feeding of Animals

(Adapted from Circular 69, Office of Experiment Stations.)

Foods.

1. Nature of feed as related to the animal.
2. Constituents.
   a. Refuse.
   b. Edible portions.
      (1) Water.
      (2) Nutrients.
         (*a*) Protein.
         (*b*) Fats.
         (*c*) Carbohydrates.
         (*d*) Mineral matter (ash).
3. Functions.
4. Classes.
   a. Roughage — kinds.
   b. Concentrates — kinds, composition, etc.
5. Composition of foods.
6. Digestibility.
7. Effects.
   a. On condition of the animal.
   b. On the product.
8. Manurial value.

Feeding standards.

Food requirements — feeds for —

Maintenance.
Growth.
Meat.
Fattening.
Wool and hair.
Milk.
Work.

Rations.
  Compounding.
  Methods of use.
  Economy.

Systems of feeding.
  Dairy cattle.
  Beef cattle.
  Sheep.
  Swine.
  Horses.

Effect of food on —
  Condition of animal.
  Product.

Practice in feeding different kinds of animals.

PRACTICUMS

1. Outline a half-year high school course in animal husbandry adapted to stated conditions as to locality, size of school, available equipment, etc. State approximate number of recitations to be given to each topic of the course.

2. Summarize lectures and outline practicums to be used in teaching any chosen topic in the animal husbandry course, as beef cattle.

REFERENCES FOR COLLATERAL READING

Course in Agriculture for the High Schools of Michigan. Michigan Agricultural College, Department of Agricultural Education Bul. 7. 1911. pp. 38–40.

SMITH, H. R. Secondary Course in Animal Production. pp. 5–7. Office of Experiment Stations Cir. 100. 1911.

CHAPTER VIII

DAIRY WORK IN THE HIGH SCHOOL

Assuming that definite animal husbandry work begins with the second year in the high school, the dairy course may well be given in either the first or second semester of that year. In some schools it may be preferable to give the general live stock course, dealing with types and breeds of farm animals and their care and improvement, during the first semester, thus providing a good general survey of the animal husbandry field as a basis for the work which is to follow. In this case dairying will usually be given during the second semester of the same year. In other schools it is argued that dairying should be made the initial course in animal husbandry, dealing largely, as it does, with the study of the universally familiar dairy products.

Good arguments may be advanced for either plan. The last is clearly in accordance with pedagogical principles, enabling us to proceed from a beginning study of certain well-known animal products to the study of what is less known, — the kinds and care of their producer, the dairy cow. From the study of this type of domestic animal, — that is, from the familiar cow, — we may pro-

Studying the Dairy Cow, Fresno (Cal.) High School.

ceed in a following course to the study of other probably less known domestic animals. Students usually have a good apperceptive basis for the study of dairying, since it deals largely with familiar things. Treating largely of products of economic use, from which profit may be made, the economic factor may effectively be utilized in presenting the work. The dairy course includes much laboratory work, — actual doing of things, — and appeals strongly to the adolescent mind. It arouses interest and curiosity, and larger classes in later animal husbandry and other agricultural courses are said to result from it as an initial course. Lastly, the study of the dairy cow forms an excellent basis for the study of the types, breeds, and care of other farm animals.

The dairy course should, rightfully, be a popular one in any high school attempting to give agricultural instruction. Dairy products are universally used and should be of almost equal interest to the town dweller and to the countryman, to the boy and to the girl, to students specializing in agriculture and to those who are taking other courses. The general principles of dairying, including the production and care of milk, are facts that any well-informed person ought to know more or less about, since milk and other dairy products are used in every household. The dairy course should therefore be freely open to all students, regardless of any preparatory work in types and breeds of farm animals.

If there are large numbers of students desiring to take the work, both boys and girls, it may perhaps be well to divide the class into sections, having a girls' section and a boys' section. In such case the work in the girls' section would probably emphasize the composition, care and handling of milk, town and city public milk supplies, the products derived from milk, and the use of milk in the home; while the boys' section, though including all those things, might perhaps emphasize the care and management of the dairy cow and herd, which is more briefly touched upon in the girls' section. Or there might be a division into mixed sections of boys and girls, one for students taking the agricultural course, the other for general students. In many high schools, however, even though there are large numbers of both boys and girls taking the dairy work, it may not be advisable to divide the class in this way. In such cases, numbers and available laboratory equipment and the convenience of the instructor would be the factors determining any division into sections.

The material chosen for the dairy course will naturally be much the same in different schools, though the emphasis placed on topics may vary widely in different localities or even, in case of division of classes into sections, in the same school. The work should include, among other topics, an elementary study of the composition of milk, butter, etc.; methods of testing milk,

cream, butter, buttermilk, and other dairy products; the manufacture, care, marketing, and uses of dairy products; planning of dairy buildings; dairy sanitation; the dairy type of cow; and the care and management of the dairy herd.

Unless the topics to be taught are prescribed and fully outlined by state or other school authorities, the teacher should carefully and completely outline the work of this, as of other courses, at the very beginning of the semester. At the close of this chapter are given outlines of dairy work as presented in various secondary schools of the country. None of these is ideal, but all of them are suggestive; and, together with any others available, they should be studied by the agricultural teacher planning to give a course in dairying in the high school.

A more extended outline than those noted here, and a very good one, is given in Bulletin 38 of the Minnesota Department of Public Instruction, on pages 65 to 66. This provides for a full year's work.

The material having been decided upon, it must then be so arranged as to present a well-organized, well-balanced course. To each part of the work should be assigned the amount of time, the number of recitations, which can best be afforded for it and which the importance of the topic warrants. Laboratory work and practicums should be planned. Lectures and reading assignments should be outlined. Circumstances may

alter the plans of the course somewhat, — and the teacher should not consider them iron-clad by any means, — but they should be a check upon the work and should enable him to keep the work better balanced than it would otherwise be. In addition, they will probably result in more work actually being done than would otherwise be the case.

In accordance with the pedagogical principle of always proceeding from the known to the less known, it is perhaps preferable to proceed, in our dairy study, from a brief general consideration or review of the various products of the dairy (milk, butter, cheese) and the by-products (skimmed-milk, whey, cottage cheese, etc.) to a study of the composition of milk, its testing, and methods of handling and caring for it. Then, after the study of milk, butter, and other dairy products as food and articles of profit, there will naturally arise a desire to consider the condition whereby the production of these articles may be increased and improved. The animals themselves will then receive attention, — the types and breeds of the dairy cow and the care and management of the dairy herd.

In the Office of Experiment Stations Circular 60 outline is given a study of the dairy cow, type, feeding, care, and management, as a preliminary to the study of milk and its products. This is a common arrangement of material, and, if the amount of knowledge which the average

student has of the dairy cow warrants it, may prove a good one. But if we utilize the economic approach to the fullest degree, we will begin with the dairy products and proceed from a study of the products to the study of the animal producing them, — studying the dairy type and breeds, their care and management, *after* our study of milk and its products. By doing this we shall also acquire a better apperceptive basis for the later work.

As to the methods to be employed in teaching dairying, — they will consist, as in other agricultural courses, of lectures, reading assignments, recitations, laboratory work, field trips, and outdoor practicums. In determining how much time shall be given to each, many factors must be taken into account. An arrangement which has been found satisfactory for a semester course is three recitations per week and two double laboratory periods. Three double laboratory periods per week and two recitations is also a popular arrangement of time.

We may or may not use a textbook. In general, however, it will probably be advisable for students to purchase at least one of the more satisfactory texts adapted to the comprehension of high school students. The number of lectures which it is necessary for the instructor to prepare will thus be lessened, and certain fundamental facts will always be available for quick reference. Any textbook will, however, need to be supplemented by occasional lectures and by reading

assignments in dairy reference books and bulletins. Among the textbooks on dairy work most used in high schools may be mentioned Wing's "Milk and its Products," Van Norman's "First Lessons in Dairying," Farrington and Woll, "Testing Milk and its Products," and Michels, "Farm Dairying."

We are particularly fortunate in secondary work in dairying in having easily available a vast wealth of extremely valuable station and Department of Agriculture material on dairy topics, much of which is popularly written. This should be freely utilized and referred to; and in many instances the instructor should endeavor to obtain duplicate copies of bulletins for the use of students. Lectures in addition to text and bulletin assignments will be on subjects that are not fully elucidated in the text, or which may more profitably be presented to students in lecture form than in the bulletins or other reference books.

The recitation in dairying will, as in other classes, sometimes consist of an oral quiz on assignments or lectures, or it may review the results of laboratory work, or it may consist occasionally of reports by different students on special reading assignments covering matter which the instructor wishes brought to the attention of the class, but which he does not wish to give in lecture form and which he does not consider important enough to be read by every member of the class. The recitations

should fix in mind facts learned, should serve as a means by which the instructor tests the knowledge of students, and should emphasize important facts. They should be varied, quick moving, and interesting.

The laboratory and other practicum work should be outlined as carefully as the recitation and lecture work. If a laboratory manual is not used,[1] the directions for the work should be carefully worked out by the teacher for each experiment or exercise, and the materials should be in readiness at the proper time. If possible, typed directions should be duplicated for each student. If there is a commercial department in the school, the instructor in that department may be glad to have students do such work for the agricultural department as practice work. Even if a laboratory manual is used, the good teacher will probably not follow it exactly, but will select, supplement, and rearrange the material as suits his work best. And, too, the indoor dairy laboratory work must be supplemented by field trips,

[1] There is as yet no really satisfactory laboratory guide for dairy work in the high school. Charles W. Melick's "Dairy Laboratory Guide" (N. Y., Van Nostrand, 1907) will, however, be found useful, even if it is not adopted for class use. It was prepared for short courses where the classes are largely made up of farm boys whose education ranges from the eighth grade through the high school; and it aims, therefore, to begin with very elementary exercises and to include only the most practical. H. E. Ross's "Dairy Laboratory Guide" (N. Y., Orange Judd, 1912) will also be found very useful. "Experimental Dairy Bacteriology" by Russell and Hastings (Bost., Ginn & Co., 1909) will be suggestive for the instructor, but it is not recommended for class use.

judging of dairy cattle, outdoor practicums, and so on. Needless to say, the laboratory work should be given in proper sequence, articulating with the textbook, lecture and recitation work, and emphasizing and elucidating them. Only in this way can the greatest good be derived from it.

Among the exercises should be included the testing of milk, cream, butter, and other dairy products; judging of dairy cows, herds, and products; operating the cream separator; making of butter, cottage cheese, etc.; balancing rations for dairy cows; and many others.

In one school, several days each winter are spent in testing cattle for tuberculosis. Students go with a competent instructor to a neighboring herd. There they are divided into squads and, with a leader for each squad who has had some experience before, temperatures are taken for several hours. Records are carefully kept and the injections made in time to return home before bedtime. The owner of the herd has learned to take the morning temperature, or a few students are sent to take them. The class and instructor chart the curves for each animal and make careful study of the results. In this work class practice is seen to be of direct benefit to the individual farmer.

Excellent suggestions as to the laboratory and practicum work will be found in the New York State Education Department Syllabus in Agriculture for Secondary

Schools, 1910, where thirty-six exercises are fully described, a list of needed materials and directions for work being given in each case. Among other publications suggestive in outlining the laboratory and practicum work, the following may well be noted: Purdue University Agricultural Experiment Station Circular 29, "Live-stock Judging for Beginners"; Purdue University School Bulletin, "Practical Studies in Agriculture for the Common Schools"; West Virginia University College of Agriculture, "School Agriculture," v. 2, No. 4, "Cattle and their Products"; Office of Experiment Stations Circular 100, "Secondary Course in Animal Production"; Office of Experiment Stations Bulletin 166, "A Course in Cheese Making for Movable Schools of Agriculture"; Vermont Department of Education, "Manual of Agriculture" (1911); and Oklahoma Agricultural and Mechanical College, Agricultural Club Series, Nos. 8 and 9, on "Butter Making" and "Milk Testing." In all of these good exercises will be found described which may be used in the dairy course.

Field trips should include excursions, at appropriate times, to well-conducted dairies in the vicinity, for the purpose of noting and judging the various breeds of dairy cattle, or to observe details of the care and management of the dairy herd. There may also be some scoring of dairy barns and dairy herds producing milk for city use, the best being scored first to establish high standards

in the students' minds. If possible, trips to creameries, to local fairs where dairy stock is exhibited, to implement or hardware houses to see different types of dairy utensils, etc., should be included. Wherever possible, the illustrative material to be found in the community should be sought out and utilized for the benefit of the class.

In connection with the dairy course, individual home project work for the student may be encouraged, — such as caring for at least one cow in a herd, with a view to securing from her the highest production of which she is capable; weighing and recording the milk yields of the herd at each milking; making frequent Babcock tests of the butter-fat content of milk; and many others. Such work is not only of advantage to the students themselves, but it helps bring the teacher in touch with their home life and enlists the interest of parents in the work. Where there is no opportunity for students to undertake individual project work in dairying at home, it may often be arranged for at other homes of the community or on the school farm. Due credit should be given for the work in all cases. Where the individual project work is not done at home and the amount of time required for it exceeds a certain limit decided upon, workers should be adequately remunerated by the school or person for whom the work is done.

The equipment for dairy work may vary widely in schools giving excellent courses. It will, however,

At Work in the Dairy Laboratory, Fresno (Cal) High School.

prove more expensive than the equipment for most of the other agricultural courses if the best work is to be done. If the school has a farm with suitable buildings, there should be some dairy stock and a good dairy room or house properly equipped for the care and testing of milk, butter making, etc. If it is not possible for the school to own or "rent" or borrow dairy stock, a definite amount of milk may be purchased daily while the dairy course is being given. With a properly equipped dairy room excellent work is then possible, though all observation and study of dairy stock must necessarily be carried on through field trips, home project work, etc. In any event, whether or not the school owns dairy stock, the illustrative materials to be found in the community in the dairy herds, creameries, etc., should be freely utilized wherever possible and advantageous.

The dairy room or laboratory should be well equipped for carrying on the work. Make-shifts are used in some schools, but it does not pay. Any reasonable expenditure to secure a well-equipped dairy laboratory will prove worth while in every way. The equipment should include all needed apparatus and materials for the testing of dairy products and for the making and care of butter. White duck suits to be worn in the dairy room should be purchased by individual students, and therefore need not be considered here.

Suggestions as to apparatus and supplies needed for

dairy work in the high school may be found in various publications, among which are the following: University of California Circular 67, pp. 48–50; Michigan Agricultural College, Department of Agriculture Education Bulletin 1, p. 37 (list of apparatus needed for the Babcock test); Office of Experiment Stations Circular 100, p. 56; Oklahoma Agricultural and Mechanical College, Agricultural Club Series, No. 9, pp. 3–5, 13 (outfit for Babcock testing and for obtaining dairy herd records). In Office of Experiment Stations Bulletin 166, "A Course in Cheese Making for Movable Schools of Agriculture," is given a list of apparatus and materials needed for that work. Much of this would not be taken up in the average high school dairy course, but a part of it might well be in many localities.

In making out a list of supplies needed for the dairy course in any particular school, the probable number of students taking the work would have to be considered, the laboratory exercises which it is planned to give, and many other questions. So that any published list is merely suggestive and to be used as a help.

The dairy division of the agricultural library should include many bulletins and a few good books. Among the latter any of the following will be found useful.

BELCHER, S. D. Clean Milk. N. Y. Orange Judd. 1903.

CONN, H. W. Bacteria in Milk and its Products. Phil. P. Blakiston's Sons. 1903.

CONN, H. W. Practical Dairy Bacteriology. N. Y. Orange Judd. 1907.

CRAIG, J. A. Judging Livestock. Ames, Ia. J. A. Craig. 1901.

FARRINGTON, E. H., and WOLL, F. W. Testing Milk and its Products. Madison, Wis. Mendota Pub. Co. 1911.

GURLER, H. B. The Farm Dairy. Chic. Breeders' Gazette. 1909.

HENRY, W. A. Feeds and Feeding. Madison, Wis. W. A. Henry. 1910.

LANE, C. B. The Business of Dairying. N. Y. Orange Judd. 1909.

McKAY, G. L., and LARSEN, C. Principles and Practice of Buttermaking. N. Y. John Wiley & Sons. 1908.

MICHELS, H. Dairy Farming. Milwaukee, Wis. H. Michels. 1911.

PLUMB, C. S. Types and Breeds of Farm Animals. Bost. Ginn & Co. 1906.

ROSS, H. E. A Dairy Laboratory Guide. N. Y. Orange Judd. 1912.

RUSSELL, H. L., and HASTINGS, E. G. Experimental Dairy Bacteriology. Bost. Ginn & Co. 1909.

SNYDER, H. Dairy Chemistry. N. Y. Macm. 1906.

VAN NORMAN, H. E. First Lessons in Dairying. N. Y. Orange Judd. 1908.

VAN SLYKE, L. L. Modern Methods of Testing Milk and Milk Products. N. Y. Orange Judd. 1912.

WING, H. H. Milk and its Products. N. Y. Macm. 1907.

In making out the bulletin list, at least those mentioned under dairying in Office of Experiment Stations Circular 94, "Free Publications of the Department of Agriculture Classified for the Use of Teachers," should be secured.

Selections should also be made from Bureau of Animal Industry Circular 106, "Publications of the Bureau of Animal Industry," and from the publications of the various stations.

If desired, a wealth of useful community work may be undertaken in connection with the dairy course. Occasional authoritative tests of milk and cream may be made for farmers. Interest in coöperative breeding and improvement of dairy stock may be aroused. Cow-testing associations may be formed. Coöperative ownership of dairy bulls may be encouraged. Evening lectures on dairying may be given, at least some of which should, if possible, be illustrated by demonstration exercises, lantern slides, etc. For example, the Office of Experiment Stations lecture on the "Care of Milk," illustrated by forty-four excellent slides, may be given; or a lecture on the dairy type and breeds, illustrated with cuts from bulletins and books. Dairy short courses and institutes may be carried on. Exhibits of dairy products may be arranged for.

The live teacher will find many ways of doing valuable work for the community along dairy lines, gaining at the same time sympathy and coöperation for his school work and respect for his instruction.

OUTLINES OF HIGH SCHOOL DAIRY COURSES

A

Dairying in High Schools

(Michigan Agricultural College, Department of Agricultural Education Bul. No. 7, 1911, p. 40.)

The work in dairying may well be confined to two general heads, viz.: —

1. Babcock test.
   - Composition.
   - Production.
     - Feeding.
     - Secretion.
2. Milk.
   - Care.
     - Cleanliness in handling.
     - Relation of bacteria to milk.
     - Creaming of milk.
       - Shallow pan setting.
       - Deep setting or cooling system.
       - Dilution methods.
       - Centrifugal separation.
     - Ripening and churning cream.
       - Process of ripening and necessary conditions.
       - Conditions affecting time and efficiency of churning.
       - Making and salting butter.

B

Dairying in the High School

(University of California Cir. 47, "Agriculture in the High Schools," pp. 14–15. 1909.)

Dairying.

A. Milk.
  1. Composition.
  2. Study of each constituent in composition; fat, casein, albumin, sugar, ash.

B. Babcock test for fat in milk, cream, butter, and cheese.
  Purchase small tester if possible.
  Specific gravity test with lactometer.

C. Production and care of milk.
  1. Cleanliness of stable, cows, vessels, and attendants.
  2. Milking, straining, aërating, cooling.
  3. Bacteria as cause of souring and other changes and flavors.
  4. Odors and flavors not caused by bacteria.
  5. Preventing and controlling fermentations.
  6. Diseases that may be carried by milk.

D. Milk and cream for home use, quality of, methods of marketing.

E. Separation of cream from milk.
  1. Gravity in pans.
  2. Centrifugal separator.
  3. The farm separator and its use.

F. Butter making.
  1. In the home.
  2. In the near-by creamery.
  3. From cream shipped to city.
  4. Ripening cream — flavors.
  5. Kinds of churns.
  6. Coloring, washing, salting, working, packing, marketing.

G. Cheese making.
  1. California and Eastern methods.
  2. Other and fancy varieties.

H. Condensed milk.

I. Field work.

1. Visit creameries or cheese factories in neighborhood.
2. Have small Babcock test in school, and pupils bring samples of milk from home.
3. Visit dairies to study cleanliness.

C

Elementary Course in Dairying

(Office of Experiment Stations Cir. 60, pp. 18–19. 1904.)

1. The dairy cow.
    - Type.
    - Feeding, care, and management.
2. Milk.
    - Composition.
        - How determined.
        - Relation to price.
    - Handling.
        - Cleanliness.
            - Stables.
            - Cows.
            - Attendants.
            - Vessels.
            - Relation to souring or tainting of milk.
        - Straining.
        - Aërating.
        - Cooling.
    - Uses.
        - For consumption as milk or cream.
            - Putting up in cans or bottles.
            - Marketing.
        - For condensing. (Putting in cans and hauling.)
        - For cheese making.
        - For butter making.
            - Creaming.
                - By setting in pans.
                - By use of separator.
            - Churning.
                - Temperature.
                - Kinds of churns.
            - Salting.
            - Coloring.
            - Working.
            - Packing.
            - Marketing.

D

Outline for Dairy Work in the Eighth Grade

(Also used in some high schools.)

(E. A. Cockefair, "Correlated Outline of Agriculture, Geography, Physiology." pp. 15–16.)

1. Anatomy of the udder.
   a. Structure.
   b. Blood supply.
2. Physiology of milk secretion.
3. Care of the cow.
4. Composition of milk.
   a. Variability and causes.
   b. Comparison with other animals.
5. Tests for butter fat.
   a. Composition of butter fat.
   b. Size of globules.
   Materials needed: milk acid, Babcock machine and equipment.
6. Separation.
   a. Setting systems.
   b. Dilution methods.
   c. The centrifugal method.
   Materials needed: thermometers.
7. Pasteurization and sterilization. Materials needed: bottles and cotton.
8. Churning.
   a. Principles involved.
   b. Use of butter color.
   c. Grain in butter.
9. Cheese making.
10. Diseases of dairy cattle.
11. Dairy countries.

Books needed.

Aikman, "Milk, its Nature and Composition."

Farrington and Woll, "Testing Milk and its Products."

Wing, "Milk and its Products."

Missouri Dairy Report, 1908.

Farmers' Bulletins Nos. 29, 42, 55, 63, 74, 131, 151, 166, 206, and 241.

E

DAIRYING

(A condensed outline taken from Office of Experiment Stations Cir. 100, "A Secondary Course in Animal Production," pp. 46–55. 1911. Work to form a part of a general year's course in animal husbandry.)

1. Milk and its products. Secretion.
2. Composition of milk.
3. Testing milk.
4. Testing milk and cream.
5. Milking.
6. Bacteria in relation to dairying.
7. The production of clean and sanitary milk.
8. Creaming.
9. Operating the farm separator.
10. How to secure good cream for sale or for butter making.
11. Butter making.
12. Churning and working butter.
13. General suggestions in making and marketing butter.
14. Visiting dairies and creameries.
15. Grading and judging butter.
16. Cheese making on the farm.
17. The making of farm dairy cheese.
18. Marketing milk and cream.
19. Visit to cheese factory.

Some of the lessons outlined under other heads in this circular also treat of dairying. For example, under cattle we find: —

Cattle, zoölogical classification.

Development of modern types and breeds.

Comparison of types of cattle (the beef and the dairy cow).

Beef breeds.

Dairy breeds — Jersey, Guernsey, Holstein-Friesian, Ayrshire.

Judging dairy cows.

Diseases of dairy cattle. (Milk fever, tuberculosis, impaction of the rumen.)

Under feeding and care of farm animals we find, under dairy cattle, the following lessons outlined: —

Feeding for milk production. Equipment.

Nutrient requirements for milk.

Feeding the fresh cow in winter.

Results of experiment station tests.

Summer feeding for milk and the care of other dairy stock. (The calf, bull, heifer.)

Rearing calves on skim milk. Relative economy of skim and whole milk in raising calves.

PRACTICUM

Draw a plan of a high school dairy laboratory of sufficient size to accommodate a class of fifteen students. List the equipment desirable for this laboratory, with itemized cost.

CHAPTER IX

THE HIGH SCHOOL POULTRY COURSE

THE study of poultry culture furnishes an animal husbandry course which is adapted to the needs and interests of many communities and which, in addition, offers special opportunities and advantages for secondary and elementary schools.

We are apt greatly to underestimate the poultry industry because it is so scattered and the proceeds are distributed among so many people. Yet in the aggregate the products of the American hen total more than $509,000,000 annually. This sum, according to the most recent statistics of the U. S. Department of Agriculture, is greater than the combined value of oats and barley for 1909. It is nearly five times the value of the tobacco crop for the same year. This value is constantly increasing, and the importance of the poultry industry advancing proportionately. Yet even now most of our city markets are fully supplied with choice quality eggs only a comparatively small part of the year, though the demand for them is increasing and the prices received are high.

It is evident, then, that the poultry industry offers opportunities for intelligent, well-informed persons practically all over the country. There is no reason why the industry should not be greatly expanded and, under proper management, meet the demands of both home and foreign markets. However, though there are many opportunities in the poultry business, and though fowls often thrive even when neglected, we have begun to realize that any real satisfaction in the rearing of poultry must come as a result of careful study and attention. By studying the questions of breeding, feeding, diseases, general management, and the application of business principles, the usefulness of all kinds of fowls and the profits from them can be greatly increased.

Poultry work may, therefore, well be made one of the agricultural courses of the high school because of the importance of the poultry industry as an agricultural occupation and the importance of poultry products as food for man. There are, however, special reasons, aside from the importance of the poultry industry and of poultry products and aside from the general reasons for teaching agricultural subjects, which make poultry culture particularly adapted for instructional purposes in secondary schools in different localities and with different conditions.

The work is suited to practically all kinds of high

schools, — except, perhaps, those of the larger cities. Poultry raising is carried on in both town and country. Poultry products are almost equally used in town and country homes. Probably no other branch of agriculture interests a greater number of people than poultry keeping. It is not limited by soil or climatic conditions; it does not require an expensive equipment; and it is reasonably profitable. The poultryman is found in every state and in every county of the Union. The farm without some poultry is almost an anomaly; and yet the farmer does not monopolize the business. The villager with his back lot, the woman in search of a livelihood, and many others besides the farmer engage in poultry raising.[1] There is probably no other agricultural subject in which there is as nearly an equal "ready-made" interest in both urban and rural districts as in poultry raising. The majority of high school pupils have a fairly good apperceptive basis for the work, and it may therefore be introduced under the most favorable circumstances.

Poultry work and poultry raising instruction is equally suited to both boys and girls. Each will be equally interested in and equally successful in the work. Poultry work can be more easily and thoroughly done by stu-

[1] Syllabus of Illustrated Lecture on the Production and Marketing of Eggs and Poultry. United States Department of Agriculture. Office of Experiment Stations, Farmers' Institute Lecture No. 10, p. 3.

dents of high school age than work with almost any other kind of live stock. It utilizes the economic approach in its presentation of material and connects the school work with the home life of a large number of the pupils, showing them the practical side of education very forcefully. It, in common with many other agricultural subjects, trains pupils to investigate for themselves; it teaches them to apply the knowledge which they may acquire; and it sustains their interest.

In many school districts the question of cost of equipment would forever prevent the raising and study of any kind of farm stock other than poultry on the school grounds. To be sure, other animal husbandry subjects may even in that case be studied in the school and the schoolroom work supplemented by visits to neighboring farms for the inspection and judging of the kind of stock studied. But only in the case of poultry can a large number of schools afford the purchase of stock and proper provision for its care.

Having decided upon the advantages of a course in poultry work for the high school, — where shall we put it in our curriculum? If there is little interest in dairying in the community, poultry work might take the place of the dairy course, in the second year of the high school, either the first or second semester. Or, better still, it might run throughout the second year, two days per week, alternating with the class in general live stock

or animal husbandry. If there is great interest in all live stock topics in the community and but little in horticulture, the poultry work or dairy work might be given half of the third year, general live stock and either poultry or dairy work being given the second year.

The materials chosen for presentation in the course should include some study of types and breeds, poultry judging, feeding, and the general care and management of farm poultry. The outline given in Office of Experiment Stations Circular 100 for poultry study as a part of the general live stock course may easily be adapted to the purpose of a special course and will be found helpful in many ways. However, other topics might well be added, and many more practicums. In a special poultry course, too, much more time would be given to the separate topics than is indicated in this outline.

The Wisconsin high school outline, which is also a part of that for the general live stock course, divides the poultry work into four divisions: (1) poultry as an economic factor in farm and city life; (2) the care and management of poultry; (3) feeding poultry and marketing poultry products; (4) judging poultry.

An excellent outline for poultry study, taking up in order statistics of poultry keeping, study of breeds, poultry houses, feeds and feeding, marketing poultry products, hatching and rearing chickens, and diseases and parasites, is given in Bulletin 38 of the Minnesota

Department of Public Instruction, "Outlines for Secondary Courses in Agriculture."

Still another outline for poultry work in the high school[1] reads as follows: —

Poultry.

- *A*. Study of breeds.
  - 1. Egg breeds.
    - *a*. Mediterranean — Leghorn, Minorca, Spanish.
    - *b*. Hamburg — Houdan.
  - 2. Meat breeds.
    - Asiatics — Brahmas, Cochins, Langshans.
  - 3. General purpose breeds.
    - Plymouth Rock, Wyandotte, Java, Dorking.
    - Rhode Island Red, Orpington.
  - 4. Fancy breeds.
    - Polish, Game, Bantam.
- *B*. Study of incubators, incubation, and brooding.
- *C*. Care and management, diseases and their control.
- *D*. Judging and scoring all breeds, fowls from the home yard.

The New York State Education Department outline for a half year's poultry work and the Maine high school outline are given at the end of this chapter.

Though it may be advisable to give the instruction in poultry work largely by means of lectures and reading assignments, supplemented by practical work, yet students should be asked to purchase at least one of the several excellent books on poultry culture. None of

[1] Anderson, Leroy, "Agriculture in the High Schools," p. 15 (University of California Circular 47).

these is ideal for a high school poultry course, but any one of several can be very helpfully used in connection with the work. Robinson's "Principles and Practice of Poultry Culture" is one of the latest of poultry books and is already used in a number of high schools. It has an excellent arrangement of material, but gives no practicums. This, however, is a fault which it has in common with practically all poultry texts. Watson's "Farm Poultry," Robinson's "Poultry Craft," Brigham's "Progressive Poultry Culture," and other books are also used in high schools as texts. The teacher expecting to give a poultry course should examine these and other poultry books carefully, choosing the one best suited to the needs of his pupils and to conditions in the locality as well as to the outline prepared for the course.

As to laboratory manuals, — there is but one for poultry work. This is by H. R. Lewis, and is entitled "Poultry Laboratory Guide." It is not ideal, and in fact it would probably not be desirable to put in the hands of high school pupils. It will, however, be found very helpful in planning the practicums for the work. The teacher should secure a copy for himself or for the school library and select from the exercises such as are suited to his needs, supplementing them by others and by field trips.

Teaching methods in the poultry course will not differ from those employed in the other agricultural courses

which have already been discussed. The lecture, recitation, quiz, laboratory work, field trips, and outdoor practicums will all have their place. In general, one-third to one-half of the class time should be given to practicum periods or field trips. In addition to this, individual home or school practice work will be carried on. This, however, is carried on outside of the regular class time for the most part, just as is the studying of reading assignments.

Poultry work has an advantage over other live stock courses in that it is possible to do much practical work indoors as well as outdoors. Fowls may be brought within the classroom when needed, and many practical laboratory exercises may be planned for the schoolroom as well as outside. Interesting school exhibits of poultry and other agricultural products studied in the school may profitably and easily be made an annual feature of the school year.

With a comparatively inexpensive equipment, work in poultry raising can be carried on with a degree of completeness possible in the case of practically no other stock-raising industry. With a few fowls and an inexpensive house, all the work of raising and marketing poultry can be done by the students. Feeds and feeding, incubation, the marketing of poultry products, and all the other features of poultry management become intensely vital and interesting with the stock actually on the school grounds and the students doing the work

of feeding and caring for the hens themselves, marketing the products, figuring the cost of feeds and the profits realized from the sale of products. Problems of the business management of a poultry venture can be worked out with considerable detail. Actual facts and figures of poultry raising may be worked with all along the line, rather than general facts and figures. The actual relations between cost of equipment and of carrying on the work can be seen and demonstrated. Valuable experimental study of feeds and feeding may be made.

Judging of poultry may not only take place at the school or on field trips for the purpose, but visits to the county fair may be arranged, where permission will probably be granted the students to judge some of the poultry and compare their scores with the work of the judges. The fair officers might be induced to offer prizes for poultry raised by the students, and exhibits of their products might be made at farmers' institutes.

Special study should be made of the different breeds of poultry found near the school, their origin, characteristics, etc. As a practicum it might be well, in this connection, to make a census of a given locality to determine whether the majority of the poultry are standard bred or scrub. Different methods of feeding poultry employed in the neighborhood should also be studied, and results compared. Poultry farms should be visited and poultry

houses inspected. Sketches should be made by students of different types of poultry houses, giving dimensions and stating the number of hens to be kept in each house, with other details.

When poultry houses are needed on the school grounds for the housing of chickens, they may well be planned and constructed by pupils. We are told that in one school where no poultry buildings were needed for the school an eight-fowl portable poultry house was planned and constructed as practice work, later being sold. The difference between the cost of materials and the purchase price was donated to the school to be used for athletic goods for the boys.

Catalogues from a large number of incubator and brooder firms should be secured when studying artificial incubation and the incubators and brooders studied and compared. Incubators in the neighborhood should be examined. The school itself should own at least one, if possible, and students should have practice in the use of the incubator and the care of young chicks in the brooder. Eggs should be tested on at least the seventh and the fourteenth day, and a brief description of the chick in the shell should be given. A broody hen should also be secured, for comparison of natural with artificial incubation, and placed in a proper nest. Students may, as a group problem while studying incubation, even construct an incubator and brooder

along lines worked out by them and approved by the class and instructor as satisfactory.

When studying the marketing of poultry, the meat markets of the town should be visited, and the displays of dressed poultry inspected. The methods of killing and dressing the poultry sold for meat in the town should also be learned, if possible.

Poultry work is rich in opportunities for special individual practicums, for class practicums performed by each student, and for group problems in which all or a number of students take some assisting part.

A valuable opportunity for community work is also afforded in connection with the poultry work in the high school. Poultry clubs might well be formed, evening lectures on poultry topics given, home experiments with poultry supervised, short courses given, and so on. Meetings for rural school teachers could also be held, and poultry work for rural schools discussed and its advantages made clear. Successful poultry raisers of the community might well be invited to talk to the pupils on topics on which they are especially well informed, or concerning work in which they have been particularly successful.

The equipment for poultry work may vary widely in different schools and yet be admirably suited to the special conditions in each case. The main requirements are, of course, the fowls, the house, and a suitable yard.

The house should be convenient, well-lighted, well-ventilated, dry, warm in winter, and sanitary, — a model in its way, — and yet it need not be expensive. If necessary, one of the small portable houses now on the market could be made very satisfactory for a small flock, or, better, a house may be constructed by students at a small cost. The house should provide space of from 3 to 7 square feet for each adult bird, if there is a good run attached to the house; otherwise a larger house space must be provided. The roosting space allowed should be from 6 to 8 inches for the smaller breeds, 8 to 10 inches for medium, and 10 to 12 for the larger.

A yard space of from 60 to 150 square feet for each adult bird is recommended by many poultry authorities, but if necessary this space may be somewhat reduced. Fences inclosing the yards may be of netting or pickets, and should be about 7 feet high. At the bottom there should be a board, if young chickens are given the run of the yard. Some provision must be made for shade in the yard. This may be given by fruit or other trees, by sunflowers, or a small portion of the yard may be covered.

Where the school has a manual training department, the poultry house may, if desired, be built by the students of that department. Coops will be needed for the confinement of hens with broods of small chickens. These,

too, may easily be constructed by pupils, as well as feeding troughs, drinking fountains, etc.

The small school might well start with as few as a dozen hens and one cock of a breed which is a favorite in the community or especially adapted to the locality. As soon as it is possible, it would be well to add a dozen of another breed, in a second house. Naturally, the first breed selected will probably be an egg breed. The next may well be a general purpose breed, or, if desired, a meat breed. Thus the types, requirements, and performances of different breeds may be studied and compared in fact and not merely learned from textbooks. If absolutely impossible to secure pure-bred stock, common mixed fowls may be used to start with, but this is not advised. It will almost always be possible to secure donations of eggs from good poultry raisers of the community, and frequently fowls themselves are gladly given. It may also be possible to secure for the school at small cost settings of eggs of desired pure-bred stock from the state agricultural experiment station and from prominent poultry breeders of the state.

An incubator and brooder and various tools and appliances will need to be purchased. However, many of the latter can, as has been mentioned, be made by pupils, either of the poultry class or of the manual training department, and their cost greatly lessened thereby.

The agricultural library should be well supplied with

both bulletins and books on poultry culture, and fortunately there is a wealth of very good material to choose from. The bulletins may be selected from the various lists already mentioned in discussing other agricultural courses and the general equipment for agriculture. The farmers' bulletins on poultry will, of course, be found especially helpful, and also the Cornell Reading Course for Farmers bulletins on poultry. Excellent poultry bulletins have also been published by the Maine, Oregon, Connecticut, North Carolina, Maryland, and Rhode Island stations.

A good collection of poultry books may be selected from the list given below.

American Standard of Perfection, as adopted by the American Poultry Association. Beaver, Pa. (Box 303). American Poultry Assn. 1911.

BRIGHAM, A. A. Progressive Poultry Culture. Cedar Rapids, Ia. The Torch Press. 1908.

BROWNE, E. Races of Domestic Poultry. Lond. Edward Arnold. 1906.

HAWKS, E. B. Science and Art of Poultry Culture. Clinton, Wis. E. B. Hawks. 1909.

KAINS, M. G. Profitable Poultry Production. N. Y. Orange Judd. 1910.

MCGREW, T. F., and HOWARD, G. E. Perfected Poultry of America. Detroit, Mich. Howard Pub. Co. 1908.

PEARL, R., and Others, comp. Poultry Diseases and their Treatment. Maine Agricultural Experiment Station, Orono, Me. 1911.

Poultry Houses and Fixtures. 7th ed. (Various authors.) Quincy, Ill. Reliable Poultry Journal. 1910.

POWELL, E. C. Making Poultry Pay. N. Y. Orange Judd. 1907.

QUISENBERRY, T. E. Poultryman's Guide. State Poultry Experiment Station, Mountain Grove, Mo. 1911.

ROBINSON, J. H. Common Sense Poultry Doctor. Bost. Farm Poultry Pub. Co. 1908.

ROBINSON, J. H. Principles and Practice of Poultry Culture. Bost. Ginn & Co. 1912.

ROBINSON, J. H. Poultry Craft. N. Y. Orange Judd. 1899.

SALMON, D. E. Diseases of Poultry. N. Y. Orange Judd. 1899.

VALENTINE, C. S. How to keep Hens for Profit. N. Y. Macm. 1910.

WATSON, G. C. Farm Poultry. N. Y. Macm. 1908.

OUTLINES FOR HIGH SCHOOL POULTRY COURSES

A

New York State Education Department Poultry Husbandry Course. (New York State Education Department, Syllabus for Agriculture in Secondary Schools. 1910. Adapted from pp. 95–103.)

POULTRY HUSBANDRY

Half-year course. (Daily, 1 laboratory period per week.)

RECITATIONS

Feeding fowls. (4–6 recitations.)
Breeds. (3–5 recitations.)
Importance of vitality. (2–3 recitations.)
Breeding. (3–5 recitations.)
Killing and picking. (1–2 recitations.)
Marketing. (2–4 recitations.)
Diseases, parasites, vices and sanitation. (3–5 recitations.)

Building poultry houses. (5–8 recitations.)
Natural incubation. (2–3 recitations.)
Artificial incubation. (2–3 recitations.)
Brooding with hens. (1–3 recitations.)
Artificial brooding. (1–3 recitations.)
Feeding chicks. (3–5 recitations.)
Fattening. (1–3 recitations.)
Capons and broilers. (1–3 recitations.)
Turkeys. (1–3 recitations.)
Ducks and geese. (1–3 recitations.)

Laboratory Exercises

Exercises 1, 2. Feed hoppers.
Exercise 3. Mixing feed.
Exercise 4. Parts of a fowl.
Exercises 5, 6. Killing and picking.
Exercise 7. Age, sex, and vitality.
Exercise 8. Egg and meat types.
Exercise 9. Making materials for killing lice.
Exercise 10. Killing lice.
Exercises 11 and 12. Houses.
Exercise 13. Coop for hen with chicks.
Exercise 14. Structure of the egg.
Exercise 15. Marketing eggs.
Exercise 16. Preserving eggs.

B

High School Poultry Course

(Outline from "Course in Agriculture for the High Schools of Maine." 1909. pp. 24–27.)

1. Poultry culture.
   a. Attractiveness.
   b. Advantages.
   c. Evidences of growth.

d. Statistics.

e. Successful poultry keeping depends upon the general, accurate, and faithful performances of many small tasks. The characteristics of the successful poultryman.

2. Purpose of poultry keeping.
   a. As a part of farm stock.
   b. As a special business.
   c. As fancy poultry.
3. Location of poultry buildings.
   a. Soil and drainage.
   b. Aspect and situation.
   c. Water supply.
   d. Laying and breeding houses.
   e. Coops and colony houses.
   f. Poultry appliances, — hoppers, nests, yards, fences, etc.
4. Types and breeds of poultry.
   a. Meat types — characteristics and breeds.
   b. Egg types — breeds and characteristics.
   c. Broiler types.
   d. Roaster and soft roaster — types and characteristics.
   e. Market types — general purpose, breeds, farm poultry.
5. Selection of breeding stock.
   a. When to select.
   b. Points to be considered.
      (1) Constitutional vigor and physical perfection.
      (2) Breed shape.
      (3) Comb and head appurtenances.
      (4) Color of plumage.
6. Anatomy of the fowl.
   a. Philosophy of the moult (growth of feathers).
   b. The bony framework.
   c. Digestive system.
   d. The ovarian system.

7. Feeds and feeding.
   a. The hard grains.
   b. The ground grains.
   c. Mixtures and mashes (wet and dry).
   d. Animal feed (beef scraps, green bone, etc.).
   e. Green feed.
8. Egg production.
   a. Egg production *vs.* meat production.
   b. Factors in egg production.
      (1) Good stock, well grown.
      (2) A variety of feed, well fed.
      (3) Suitable buildings.
      (4) Exercise.
      (5) Sympathetic interest.
9. Incubation.
   a. Selection of eggs to set.
   b. Natural *vs.* artificial incubation.
   c. Setting hens.
   d. History of artificial incubation.
   e. Chinese and Egyptian methods.
   f. Modern types of machines.
   g. Temperature.
   h. Ventilation.
   i. Moisture.
   j. The unknown factor (carbon dioxide).
   k. Lime assimilation.
   l. Manipulation of the eggs — turning, cooling, etc.
10. Embryology.
   a. Growth and development of the embryo in the shell.
   b. Blood rings, dead germs.
   c. Rotten eggs.
   d. Chicks fully formed dead in shell.
   e. Cripples.

11. Brooding.
    a. Natural *vs.* artificial methods.
    b. Coops for hens and chickens.
    c. Brooders — types and systems.
    d. Chinese and Egyptian methods.
    e. Fireless brooders (Philo system).
    f. Temperature.
    g. Ventilation.
    h. Summer *vs.* winter brooding.
12. The chick.
    a. Management.
    b. Feeds.
    c. Mortality.
        (1) Ænemia — symptoms.
        (2) Diarrhœa — symptoms.
        (3) Pneumonia — symptoms.
        (4) Lung weakness — symptoms.
13. Growing young stock.
    a. Houses and appliances.
    b. Management.
    c. Range.
    d. Feeds.
    e. Selection.
    f. Broilers.
    g. Roasters.
    h. Caponizing.
    i. Soft roasters.
14. Fattening and killing.
    a. Pen fattening.
    b. Crate fattening.
    c. Machine fattening.
    d. Feeds.
    e. Killing.
        (1) Dislocation.

(2) Sticking.
(3) Bleeding.

f. Picking.

(1) Scalding.
(2) Dry picking.

15. Marketing.

a. Drawn or undrawn.
b. Shaping.
c. Trussing.
d. Packing — in barrels; in boxes.
e. English and French methods.

16. Dressed poultry.

a. Weight.
b. General appearance.
c. Fleshing — finish.
d. Softness — mellow to the touch.
e. Texture.
f. Faking.

17. Eggs.

a. The structure of an egg.
b. Grading — weight, size, color, and uniformity.
c. Appearance at candling.
d. Packages.
e. Preservatives.

(1) Cold storage.
(2) Water glass.
(3) Lime water.
(4) Salt.

18. Duck culture.

a. Breeds of.
b. Houses.
c. Feeds.
d. General management.
e. Incubation of eggs.

f. Rearing young stock.
g. Marketing.

19. Geese and turkeys.
a. Breeds.
b. Housing.
c. Feeding.
d. General management.
e. Hatching and rearing of young stock.

20. Insects and diseases.
a. Insects.
b. Common ailments.
c. Contagious diseases.
d. Remedies.
e. Prevention better than cure.

PRACTICUMS

1. Make a list of equipment for use in connection with a high school poultry course, to cost not over $75. Assume that one dozen pure-bred fowls and a cock are donated by an interested school patron. In case buildings or appliances are to be made by students, give approximate cost of materials, and state arrangements to be made for doing the work.

2. Draw to a scale plans for a poultry house and runs for a high school where it is the intention to keep about two dozen hens, one-half of which belong to an egg breed while the others are of a general purpose or meat breed.

CHAPTER X

HORTICULTURE

THE high school course in horticulture may be given during either the sophomore or junior year. The junior year is usually considered preferable, in some cases because it is not thought well to defer all animal study as late as the third year, and in other cases because it is considered desirable for students to have a preliminary course in botany during the sophomore year.

If the community is one particularly well adapted to horticultural pursuits, the course should extend throughout the year. If live stock interests are paramount, the work in horticulture may be confined to one half year and the other half given to a special live stock course. If the main farm enterprises of the community are the raising of staple field crops, as hay, grain, tobacco, or cotton, one-half of this year may be devoted to a special study of field crops.[1]

[1] Where it seems advisable to give one-half of the third year to a special study of field crops, supplementary to that given in connection with first year work, the crops studied will naturally be those of particular interest or importance locally, as corn, cotton, sweet potatoes, etc., for the South, and hay, wheat, oats, etc., in the North. Useful outlines for crop study will be found in the Maine and Minnesota outlines for high school courses in agriculture; and many suggestions as to laboratory

The materials included in the horticultural course probably vary in different sections more than those of any other agricultural course given in the high school. This is true not only because of the great variation as to the fruits which can be grown in a given locality, but also because of the diversity of opinion as to what topics should be included in the high school horticultural course. For example, Professor C. P. Halligan, of Michigan, believes that the ideal course in horticulture for the high schools of Michigan would be comprised of work in plant propagation combined with vegetable gardening. In certain California schools it is thought that the course in horticulture should be limited to a study of orchard, vine, and small fruits, after a preliminary study of plant propagation. The New York State Education Department "Syllabus in Agriculture for Secondary Schools" suggests only apple growing and general fruit growing for the horticultural work. Some agricultural teachers believe that the work in horticulture should be largely limited to one or two phases of the subject; still others believe that the course should be a general one, including work in plant propagation, orchard and bush fruits, viticulture, vegetable gardening, and even landscape gardening and floriculture.

and field work are given in the publications listed in Chapter VI. Wilson and Warburton's "Field Crops" is intended as a high school text for field crops. Duggar's "Southern Field Crops" is intended "for advanced high school and for college."

It is argued that, according to the last plan, a general survey of the subject would be acquired which would be much the same in schools everywhere. The special fruits, vegetables, flowers, and trees studied under the various divisions of the subject might, however, differ almost entirely in high schools in different parts of the country, to suit the local conditions. For example, the citrus fruits, nuts, grapes, etc., most studied in Southern California would be almost ignored in the majority of Eastern high schools, — and properly so, since the kinds and varieties of fruits grown there are quite different. Many vegetables to which considerable time should be given in the South would be unprofitable subjects of study in the North. While the broad, general outline mentioned would serve for schools all over the country, yet the special fruits and vegetables to be studied might well, as has been said, be quite different in different schools.

Where the horticultural course extends through a full year, this scheme seems by far the wisest for the organization of the work; and even where the course is limited to a half year it will probably usually be found well to give this broad, general survey of the horticultural field. In this case, however, the number of special fruits and vegetables to be studied must, obviously, be very limited.

There should be included, then, in the horticultural work of every high school a review of methods of plant

Studying Trees before Pruning, Hanford (Cal.) High School.

propagation studied in the first year agriculture work, with additional study and practice in the propagation of plants by cuttings, budding, grafting, etc. This should be followed by a general survey of the subject of pomology and some special study of the more important orchard, vine, and small fruits grown in the locality.

In this special study the botanical relations, origin, and history of each of the fruits studied may well be taken up first, followed by a study of its horticultural importance and food value, the extent of its cultivation, soils and localities to which it is adapted, plant food needed, and the methods of propagation, planting, culture, training, and pruning which are considered to give the best crop results. Irrigation should be considered in localities where irrigation is practiced. Varieties of local importance should be noted. Pupils should become familiar with the more common injurious insects and diseases and with the methods of combating them. Methods of harvesting and marketing should be studied.

Olericulture or vegetable gardening may well follow the work in pomology. After a brief consideration of the kinds of vegetable gardening and its importance as an industry, the class should become familiar with the different kinds of vegetables and should study in some detail the history, uses, propagation, culture, and marketing of the more important vegetables of each class. The growing of vegetables should be considered primarily

from the viewpoint of the home vegetable garden, but commercial aspects and the growing of vegetables as an agricultural industry should not be ignored.

Probably no agricultural subject can be taught more effectively in the high school than vegetable gardening. Students can plan and carry out the growing of vegetables from start to finish. They can begin with the study of seed catalogues and estimate and order the seed needed; they can prepare the soil, seed, transplant, thin, and cultivate; and they can even harvest and market many of the common vegetable crops within the time limits of the course. They may also, if there is a domestic science department in the school, and co-operation can be arranged, see and hear at least a little of the many ways in which these vegetables may be prepared for food and of their value to man as food.

After an elementary but practical study of vegetable gardening, the horticultural course should include a few lectures, at least, upon the general principles of landscape gardening and on floriculture, accompanied by as many practicums as possible. If the course is limited to one-half year, it is evident that little time can be taken for this. But in a year's course probably at least four weeks could well be given to the landscape gardening and two weeks to floriculture. In cold climates it might be preferable to give the landscape gardening and floriculture during the winter weeks, immediately

following the pomology, which would probably take all of the first semester. The vegetable gardening should then be given last in the course, taking about the last twelve weeks of the second semester.

At the close of this chapter is given an outline for high school horticulture, prepared for a California high school, following the lines suggested. Accompanying it are other outlines showing the character of the work recommended or carried on in other schools. Bulletin 38 of the Minnesota Department of Public Instruction gives interesting outlines for one-semester courses in vegetable gardening and in fruit growing.

There is for horticulture, as for other high school agricultural courses, no ideal textbook. Bailey's "Nursery Book," "Pruning Book," "Principles of Vegetable Gardening," and "Principles of Fruit-growing" are all considerably used in the East and Middle West, as also Fletcher's "How to make a Fruit Garden," and Green's "Gardening." In California, Wickson's "California Fruits" and "California Vegetables" are naturally most used.

It is evident that there is a rich opportunity for varied, useful, and interesting laboratory work and field practicums in connection with the wide field of topics covered in high school horticulture. Opinions differ as to the amount of time which should be devoted to the practical work, but it is probably safe to say that it should be

not less than one-third of the class time, and that one-half is desirable. The University of California in its recommendations as to high school horticultural work suggests that one-fifth of the time be given to indoor laboratory and greenhouse work, two-fifths to outdoor practicums, and two-fifths to classroom, recitation, and lecture work.

So numerous and interesting are the horticultural practicums possible in connection with the work that the chief difficulty of the teacher in deciding upon the practical work will probably be one of selection. However, since the propagation of plants, especially propagation by seeds, has already been considered in first year agriculture and possibly in botany, the practical work along these lines can be limited somewhat and most of the time used for other things. Yet practice in propagation by cuttings, layers, budding, etc., should not be omitted, and students should have ample opportunity to become familiar with methods of making the various kinds of grafts, of preparing grafting wax, and other processes.

Time can occasionally be economized by substituting demonstrations or group exercises for individual practicums. This must never be at the expense of the pupil's thoroughness of knowledge, however, and, in general, he will need to learn by doing things himself.

In connection with the vegetable gardening work, opportunity should be given, as has been indicated, for

practical garden work. Individual school gardens are desirable wherever possible. If they cannot be provided, each student should have an individual garden at home, cared for under the supervision of the horticultural teacher, and there should be a general garden on the school grounds.

The garden grounds may be plowed and harrowed by the school farm superintendent or other help, if desired, but all other garden work should be done by the students themselves. They should mark out and prepare the plots for seeding, plant seeds in the seed-bed and the garden plot, transplant, thin, cultivate, and, finally, harvest and market the crops so far as is possible.

Opinions differ as to the size desirable for individual gardens. One school recommends plots 13 by 45 feet; another recommends 10 by 30 or 40 feet; another 5 feet by 1 rod; and still another 12 by 34 feet. Various factors must be taken into consideration, — the ground available, the amount of time which it is desired to devote to the work, the climate, and so on. Each teacher will have to determine for himself the size best suited for individual gardens at his school. In general, however, it should be said that they should be large enough to give practical demonstrations of the best methods of growing the vegetables selected for a home garden, but should not be so large that any student will be unduly burdened by the entire care of his garden.

The growing of certain vegetables may be required of all members of the class, but opportunity should also be given for each student to select and grow, to the best of his ability, other vegetables and flowers. It is recommended by D. J. Crosby, formerly of the United States Office of Experiment Stations, that the experimental or contest idea be put in the work. The boy who has worked in a garden more or less at home will then not complain because he is asked to go out and do weeding, thinning, or other things that he feels he knows how to do perfectly well. The object of raising vegetables will be accompanied by another object which will renew his enthusiasm in case he is inclined to weary in his well-doing.

While it is the usual practice, and preferable, for each individual garden to represent a miniature kitchen garden, yet in many schools the garden space is divided into plots, each of which is given up to the growing of varieties of a particular kind of flower or vegetable, as tomatoes, or potatoes, and pupils work on all the plots. This is practically the same thing as having one large common garden.

Both community and individual plots have their advantages and disadvantages. Probably the ideal arrangement calls for some work in each. It is usually more difficult to interest high school pupils in a common garden than in individual plots, so strong is the

instinct for personal possession of property in the adolescent. Moreover, the individual plot gives training in responsibility and independence, teaches the privileges and responsibilities of ownership, and inculcates respect for the property of others. But, on the other hand, the community garden teaches harmonious coöperation and altruism, both important lessons. Where feasible, then, each pupil should work an individual garden plot independently, giving some time to the care of a class community garden.

Interest in the community garden may be aroused in various ways, among which is the organization of the class in a sort of gardening club, the purpose of which is not only to make a successful garden as a part of the work of the horticulture class, but that it may return financial profit to the class or "club." The profits may go to purchase athletic goods for school teams or for permanent club or class memorials at the school, in the form of books, pictures, or other useful or ornamental properties. This gives incentive for the work and insures better coöperation. When the proper selection of varieties of vegetables to be raised, or the manner of planting, cultivating, and harvesting, means profit to the class, seed catalogues and cultural methods become matters of vital interest. Needless to say, in case this plan is followed, the cost of seeds and hired labor should be deducted from the class profits. This brings

up the subject of cost of production and affords an opportunity for keeping of records and accounts, emphasizing the commercial aspects of vegetable growing in a useful way.

In both the individual and community gardens it is desirable, so far as is feasible, to place students on their own responsibility, — to require them to plan their work and work their plan, — though all is subject to the suggestion and criticism of the teacher.

Among the indoor laboratory exercises which may be given in connection with this work is the planning and drawing to a scale of vegetable and fruit gardens for different sized families, with the object of providing a succession of fresh fruit and vegetables in the needed quantities throughout as much of the year as possible, from the home garden. Working drawings may be made for hotbeds, and cold frames, which may later, if desired, be constructed and used by the class. The kind and amount of seeds and plants required for a given-sized garden may be estimated and sample orders made out.

In connection with the fruit-growing part of the horticultural course, students may, as indoor work, trace upon outline maps of their state the boundaries of the different fruit districts. Areas especially adapted to the growing of the various fruits should be marked. The character of each region should be indicated, the ele-

vation, soil peculiarities, rainfall, etc. Drawings should be made for the notebook showing the proper method of making different kinds of grafts. Plans for the home orchard should be made, drawn to a scale, indicating method of placing trees, kinds of trees, etc. The common sprays may be mixed in the laboratory, and grafting wax made.

Among the field trips will be excursions to nurseries to inspect nursery stock of different kinds and ages, trips to different kinds of orchards to note effects of different kinds of pruning, trips to vineyards, to packing houses, to public markets, and even to canning factories if possible. Collection should be made, at least during the first year that horticulture is given, of typical specimens of the leading varieties of fruits grown in the vicinity. As many of these as will be useful should be properly preserved in glass jars and kept in a permanent school exhibit for the use of future classes. Insects troublesome to common fruits may also be collected for a similar purpose. But the fact should be emphasized that when materials are collected in this way for future as well as present reference and use, sufficient preparation should be made for taking care of them properly. Materials should be suitably mounted or preserved and carefully labeled and catalogued, that they may always be in shape for convenient use and not likely to be destroyed.

As outdoor practicums, students should have practice in budding, grafting, and pruning fruit trees, grape vines, and small fruit bushes; they should not only mix the different sprays, but they should have practice in applying them. They should mark out orchards in vacant lots according to different planting systems; and they should plant at least a few trees on the school farm or elsewhere.

Ornamental trees on the campus, fruit trees on the school farm, and the school vineyard will all furnish opportunities for practical work in pruning. In many high schools excellent practice work is also done in the orchards and vineyards of the surrounding community. Where the school farm does not furnish sufficient opportunity for practice, the community must be resorted to. In one school, we are told, "Work was done in trimming raspberries, blackberries, currants, grapes, and vines of all sorts all around town." Students in the same school one year pruned an old orchard across the street from the school building, and the next year sprayed it.

In the landscape gardening work there should be, among the indoor practicums, the making of simple planting plans for the home and for the school grounds, first, in their present condition, and, second, showing suggested improvements. Buildings should be drawn to a scale on these plans, and all trees and shrubs numbered. With each planting plan should be a key, refer-

ring to the numbers, explaining what kinds of plants are used and what ones it is proposed to add, with an itemized estimate of the probable cost.

In connection with the floriculture there may be sowing of flower seeds, mixing of soils, potting seedlings, and repotting larger plants. Window gardens may be planned and started and plans for flower beds made.

The general tendency in many schools is to neglect the important laboratory and outdoor work and to emphasize the textbook and lecture work. Too much cannot be said against this neglect of the practical. And yet, on the other hand, in a few schools there seems to be an almost equally undesirable tendency toward the other extreme. It should not be forgotten that while field work is necessary, it is as a means to an end. It is an essential factor in training; it supplements the class work and is a part of the process by which we should obtain definite educational results. But it is only a part of the process. The acquisition of thorough knowledge of the facts and principles governing operations must accompany field work if it is to have the best results. The doing of pruning, grafting, gardening, and other horticultural work lacks educative value when the principles underlying the work are neglected, however well the work may be performed.

Suggestions as to laboratory work and outdoor practicums in horticulture are given in various publications.

One of the most useful of these is Office of Experiment Stations Bulletin 178, a "Course in Fruit Growing for Movable Schools of Agriculture." This gives directions for over sixty excellent exercises and, in addition, outlines lectures and reading assignments. The New York State Education Department "Syllabus in Agriculture for Secondary Schools" (1910) gives directions for thirty-eight exercises, with reading references; the Maine "Course in Agriculture for High Schools," published by the State Superintendent of Public Instruction, gives useful outlines and a considerable number of exercises; the Michigan Agricultural College Department of Agricultural Education Bulletin No. 7 (1911), "A Course in Agriculture for the High Schools of Michigan," suggests many others. Helpful suggestions will be found also in Oklahoma Agricultural and Mechanical College Teachers' Series, No. 4, 1912, "Oklahoma School Hotbeds"; West Virginia State College of Agriculture, "School Agriculture," vol. 2, 1911, No. 2, "Lessons on Fruit Growing"; Farmers' Bulletin 157, "The Propagation of Plants"; Farmers' Bulletin 218, "The School Garden"; University of California Circular 59, "Tree Growing in the Public Schools"; Fletcher, S. W., "Elementary Course in Horticulture for the High Schools of Michigan," published by the State Superintendent of Public Instruction as Bulletin No. 28, in 1908; and Palmer, C. F., "Elementary Horticulture for California Schools."

A part of the school farm will be given up, as has been indicated, to school gardens for the horticulture class and to small orchard and vineyard tracts planted by the class to illustrate class work. In addition, a part of the farm should be devoted to horticultural demonstrations and experiments for the benefit of the community. New fruits and vegetables should be grown for observation and testing. New varieties of fruits and vegetables already grown in the community should be tried for comparison with the varieties commonly grown. Experiments in hybridizing and selection may well be carried on, as also in budding and grafting.

The equipment for the work in horticulture should, if possible, include a greenhouse, a lath-house, or both. Needless to say, they should be conveniently located for class work and for the care of plants, and should be properly equipped with benches, flats, flower pots of different sizes, soil sieves, and other needed materials and tools. In cold climates the greenhouse is necessary for the best kind of work, but in a warm climate, like that in parts of California, a lath-house may be made to serve many of its uses very satisfactorily.

In the greenhouse much of the plant propagation work of both the first year and the horticultural course will be carried on. Plants grown here will furnish materials for botany and other laboratory work. Here a place and opportunity is offered for much valuable problem

and demonstration work, a place is provided where seedlings can be grown for later transplanting to the school gardens or elsewhere, for growing tender plants which do not do well out-of-doors, for practical work in inclement weather, and for many other purposes. Sufficient space should be provided in the greenhouse for all members of a class to work at the benches; and there should be adequate storage room for flats, pots, soils, soil sieves, and other tools. A part of the space under the benches may be utilized for storage, but it is preferable to have a small room connected with the greenhouse for this purpose. The space under the benches can then be used for ferns, bulbs, and other plants which like shade and dampness.

The lath-house may, as has been said, be made to take the place of the greenhouse in certain climates; and nearly everywhere it will be found useful. Its chief use is perhaps to shelter and protect such plants as require plenty of shade and moisture for their best development; but it also furnishes a comfortable place to work in hot weather, if provided with suitable benches. It serves to accommodate flats of seedlings of such plants as are, for the time, unsuited to outdoor culture; it is a good place for hardening off greenhouse plants which are later to be put outside; and it may be used for many other purposes. In addition, the cost of a lath-house ($20 to $30) is very low compared with that

At Work in the Greenhouse, Oxnard (Cal.) High School.

of a greenhouse. Where a greenhouse is necessary, the lath-house may be dispensed with. But in warm climates where the use of the lath-house is feasible, it is recommended.[1]

For outdoor practicum work in horticulture, garden space, garden tools, seeds, grafting and budding knives, a spray pump, and various other tools will be required. For the indoor work many of the materials and much of the apparatus needed for botany and for first year agriculture will be utilized, together with charts showing cuttings, grafting, etc., charts and collections illustrating the life history of injurious insects, a sample collection of fruit baskets and crates, drawing tables, material for making grafting wax and sprays, and various other materials.

On pages 99 to 100 of Office of Experiment Stations Bulletin 178, "Course in Fruit Growing for Movable Schools of Agriculture," a good list of apparatus and materials is given, with cost. Suggestions as to equipment may also be obtained from University of Wisconsin Bulletin 441, high school series No. 12, "The High School Course in Agriculture," pp. 21 to 23; Josiah Main's "Educational Agriculture," pp. 58 to 59 (published by the Western State Normal School, Hays, Kansas); C. F.

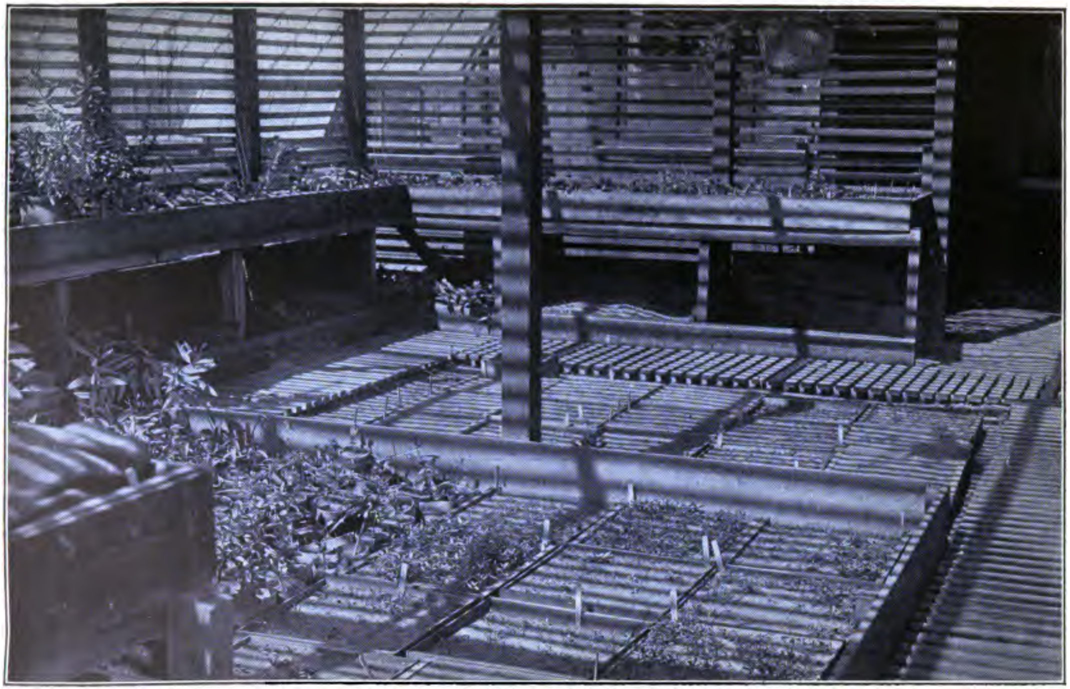
[1] For a description of a lath-house and notes as to its construction and cost, see Palmer, C. F., "Elementary Horticulture for California Schools," pp. 32–36.

Palmer's "Elementary Horticulture for California Schools" (Los Angeles, Cal., Normal School Bulletin); and similar publications.

The library should contain at least all of the United States publications on horticulture listed in Office of Experiment Stations Circular 94, "Free Publications of the Department of Agriculture Classified for the Use of Teachers," many of the publications listed on pages 97 to 99 of the "Course in Fruit Growing for Movable Schools," and all bulletins and circulars of the State Experiment Station on horticulture. A generous selection from the publications of other state experiment stations, state boards of agriculture and horticulture, and the publications of horticultural societies will also be found useful; and, not least important, there should be a good collection of catalogues and other publications of reliable nursery firms of the state.

Students in the horticulture class may well be encouraged to collect for themselves state and government bulletins and circulars on horticultural topics, nursery catalogues, and similar free publications. They will not only prove valuable for reference to the student and in his home, but much valuable information will be picked up incidentally while collecting them.

A good book list for the school horticultural collection may be selected from such publications as the following: —



Interior of Lath-house, Gardena (Cal.) High School.

BAILEY, L. H. Evolution of our Native Fruits. N. Y. Macm. 1906.

BAILEY, L. H. Farm and Garden Rule-book. N. Y. Macm. 1911.

BAILEY, L. H. Manual of Gardening. N. Y. Macm. 1910.

BAILEY, L. H. Nursery Book. N. Y. Macm. 1907.

BAILEY, L. H. Principles of Fruit Growing. N. Y. Macm. 1911.

BAILEY, L. H. Principles of Vegetable Gardening. N. Y. Macm. 1908.

BAILEY, L. H. Pruning Book. N. Y. Macm. 1907.

CARD, F. W. Bush Fruits. N. Y. Macm. 1908.

CHITTENDEN, F. H. Insects Injurious to Vegetables. N. Y. Orange Judd. 1907.

FLETCHER, S. W. How to Make a Fruit Garden. N. Y. Doubleday, Page & Co. 1906.

FRENCH, A. How to Grow Vegetables. N. Y. Macm. 1911.

GREEN, S. B. Popular Fruit Growing. St. Paul, Minn. Webb Pub. Co. 1912.

GREEN, M. L. Among School Gardens. N. Y. Charities Pub. Co. 1910.

HUME, H. H. Citrus Fruits. N. Y. Orange Judd. 1910.

LODEMAN, E. G. Spraying of Plants. N. Y. Macm. 1908.

MAYNARD, S. T. Successful Fruit Culture. N. Y. Orange Judd. 1905.

PADDOCK, W., and WHIPPLE, O. B. Fruit Growing in the Arid Regions. N. Y. Macm. 1910.

REXFORD, E. E. Home Floriculture. N. Y. Orange Judd. 1903.

SANDERSON, E. D., and JACKSON, C. F. Elementary Entomology. Bost. Ginn & Co. 1912.

SAUNDERS, W. Insects Injurious to Fruits. Phil. J. B. Lippincott. 1900.

UNDERWOOD, L. The Garden and its Accessories. Bost. Little, Brown & Co. 1906.

WATTS, R. L. Vegetable Gardening. N. Y. Orange Judd. 1912.

WAUGH, F. A. Beginner's Guide to Fruit Growing. N. Y. Orange Judd. 1912.

WAUGH, F. A. Fruit Harvesting, Marketing, and Storing. N. Y. Orange Judd. 1901.

WAUGH, F. A. Landscape Gardening. N. Y. John Wiley & Sons. 1911.

WAUGH, F. A. The Landscape Beautiful. N. Y. Orange Judd. 1910.

WICKSON, E. J. California Fruits. San Francisco. Pacific Rural Press. 1909.

WICKSON, E. J. California Vegetables. San Francisco. Pacific Rural Press. 1910.

Among the phases of community work which may be carried on by the horticultural teacher are lectures, illustrated where possible by demonstrations and lantern pictures;[1] short courses; horticultural institutes; fruit and vegetable exhibits, etc.

A horticultural "at home" day at the school, when farmers and others interested are especially invited to inspect the school gardens, the greenhouse, orchards, vegetable and fruit exhibits (either in the permanent collection or from the crops of the year), might be made very interesting and mutually helpful. An excellent program could be arranged in connection with this, if

[1] Office of Experiment Stations Farmers' Institute Lecture 14, "Farm Home Grounds," may be found useful in this connection.

desired, at which successful fruit growers might be induced to give their experience and methods. Students might demonstrate methods of making grafts, budding, and other horticultural processes; fruits raised on the school farm and canned, preserved, or jellied by students of the domestic science department might be shown and perhaps served at a simple luncheon; vegetables raised on the school grounds could be prepared and served by the domestic science department and talks given on the food value of these products.

Innumerable pleasing methods of school and community coöperation suggest themselves and can readily be worked out by the interested teacher. The chief difficulty is that time is all too short to carry out as many of the interesting and educative possibilities as the alert teacher will desire.

OUTLINES FOR HIGH SCHOOL WORK IN HORTICULTURE

A

Outline for horticultural work in the high school. (University of California Circular 47, "Agriculture in the High Schools," pp. 13–14.)

I. Horticulture and viticulture.
   A. Study fruits and vines of California and home regions.
      1. Varieties.
      2. Methods of growth, propagation, pruning, irrigation and cultivation.
      3. Crops — harvesting, marketing.

4. Insect enemies — study of chief classes of insects, and the methods of combating them.
5. Diseases — bacteria and other causes of disease and methods of prevention and control.
6. Birds in their economic relation to fruit grower and farmer.

B. Field work (in neighboring orchards and vineyards).

1. Pruning and treating wounds.
2. Review of budding, grafting, etc.
3. Examination of insects and fungous diseases.
4. Mixing sprays and spraying.
5. Cultivation and irrigation.
6. Gathering and preparing fruit for market.

II. Forestry and ornamenting school and home grounds.

B

COURSE IN HORTICULTURE, BAKERSFIELD (CAL.) HIGH SCHOOL

The following description of the horticultural work in the Bakersfield, Cal., High School is furnished by the agricultural instructor, Mr. F. H. Tout.

The work as outlined follows closely Wickson's "California Fruits and How to Grow Them."

Laboratory experiments include the following: —

1. Preparation of grafting waxes. (Later each student uses his individual waxes for grafting.)
2. Preparation of bordeaux mixture.
3. Preparation of lime sulphur salt.
4. Preparation of potassium sulfide spray.
5. Preparation of calcium arsenate.
6. Preparation of kerosene emulsion.

Among the practicums are: —

1. Preparing cuttings of many different plants and planting same in garden plots.

2. Grafting by all the best methods.
3. Budding by all the important methods.
4. Planting of school farm orchard.

The field trips of 1911–1912 included excursions to a neighboring orchard to prune large peach trees; to Edison, Cal., to study citrus culture in all phases; to a berry farm to study pruning, diseases, and care of berry plants.

C

COURSE IN HORTICULTURE, GARDENA (CAL.) HIGH SCHOOL

The Gardena (Cal.) High School course in horticulture is described as follows by Mr. C. F. Palmer, until July, 1912, in charge of the horticultural work of the school.

"We use Wickson's 'California Fruits' as text and try to actually get practice in all the main operations connected with the raising and care of fruit and nut trees, etc., seed planting and care, budding, pruning, spraying, grafting, cultivating, etc. Most of our work is out-of-doors practice work, — not more than one-fifth of the time is spent in text work.

"We have spraying apparatus, pruning shears, saws, etc., an orchard of over 100 kinds of nut and fruit trees, about forty varieties of grapes, many varieties of berries, nursery, etc."

D

A year's course (36 weeks) in horticulture, including instruction in pomology, olericulture, landscape gardening, and floriculture. (Pomology about 18 weeks, Olericulture about 12 weeks, Landscape Gardening and Floriculture about 6 weeks.) Outline prepared by the authors for a California high school in a leading fruit production county.

A. GENERAL INTRODUCTORY LECTURES

I. Definition of horticulture. What is included under the term "horticulture," — pomology or fruit growing, landscape gardening, etc.

II. Pomology. Kinds of fruits: orchard or tree fruits; vine fruits; small fruits. Semi-tropical fruits.

III. The geography of fruit growing. Determinative factor in fruit growing (climate). Temperature, moisture, soil, and parasites as determinant factors. (Very general consideration of these topics.) Fruit-growing districts of the United States.

IV. California as a horticultural state.
1. Climate of California. Chief local modifications. Topographical and climatic divisions of California: coast, valley, mountain, and foothill.
2. Relation of California climate to fruit growing. Why favorable to the growth of fruits.
3. Soils of California considered with reference to fruit growing. Note soil survey maps and bulletins.
4. History of fruit growing in California.
a. Native or wild fruits.
b. Horticulture in the Mission and Spanish period.
c. Development during American occupation. Introduction of new varieties.

B. General Lectures on Fruit Culture

The general lectures on fruit culture may be preceded, if desired, and if there is time, by lectures on the choice of a fruit farm and the factors to be considered in its selection.

I. Preparation of the land for fruit.
1. Clearing. Methods, implements used, and cost.
2. Leveling.
3. Drainage.
4. Tillage.
5. Laying out for planting.
a. In squares.
b. Quincunx planting.
c. In equilateral triangles.

II. Planting the trees in orchards.
1. Digging holes, shooting holes.
2. Tree setters.
3. Selecting trees.
4. Time to plant.
5. Operation of planting. Depth, etc.
6. Cutting back when planting.

III. Tillage of orchards.
1. Purposes.
2. Winter cultivation.
3. Summer cultivation.

IV. Fertilization for orchards and vineyards. (Treated in a very brief and general way.)
1. When necessary.
2. What fertilizers to apply. Brief discussion of various kinds of fertilizers and green manure crops.

V. Irrigation of orchards and vineyards.
1. Fruit grown with irrigation.
2. Fruit grown without irrigation.
3. When to irrigate.
4. Relation of rainfall to irrigation and relation of soil to irrigation.
5. Relation of tillage to irrigation.
6. Methods of irrigation.
7. Drainage and irrigation.

VI. Budding and grafting.
1. Processes.
2. Kinds.
3. Materials.
4. Stocks.
5. Working over old trees.
6. Time for grafting, etc.

VII. Pruning.
1. Practical purpose of pruning in California.
2. Form of tree best suited to California conditions, and how to secure it.
3. Time for pruning.
4. Pruning bearing trees.
5. Pruning tools.
6. Disposal of prunings. Thinning fruit.

VIII. Nursery methods in California.
1. Location for nursery.
2. Soil for nursery.
3. Preparation of ground.
4. Growing of nursery seedlings of the various fruits.
5. Fruit trees for cuttings.
6. Planting out of nursery stock.
7. Irrigation.

C

Orchard fruits: peach, nectarine, plums and prunes, apricot, apple, pear, cherry, and quince.

A full sample outline is given for the peach. Other fruits may be studied, following similar outlines.

The Peach

I. Botanical relations.

II. History.
1. Original habitat.
2. Geographical distribution.
   a. General throughout the world.
   b. In the United States and especially in California.
3. Brief history of the development of peach culture in California.
4. Peach crop of California. The outlook for the peach-growing industry.

III. Climate.
1. Localities unsuited for successful peach culture.
2. Localities best adapted for peach growing for commercial purposes.
3. Influence of different exposures.

IV. Soil.
1. Soil ingredients withdrawn by peaches.
2. Soils best adapted to peach growing.
3. Peaches on various stocks as related to soils.
4. Improvement of soils for peach growing.

V. Propagation of the peach.
1. Growing peaches from seed.
2. Growing from cuttings and layers.
3. Budding the peach.
4. Grafting the peach.

VI. Cultural methods.
1. Planting.
   a. Distances in orchard, number of trees per acre. Age of tree when planted, etc.
2. Cultivation of peach.
3. Irrigation and drainage.
4. Pruning the peach.
   Cutting back the peach.
5. Working over peach trees.
6. Thinning.

VII. Harvesting, preservation, and marketing.
1. Time of harvesting.
2. Influence of ripening on composition.
3. Picking, packing, and shipping fresh fruit.
4. Picking peaches for drying. Pitting, peeling, drying and preparing for market.

VIII. Varieties.
1. Importance of variety.
2. Varieties adapted to certain locations.

3. Popular varieties in California.
4. Varieties of California origin.
5. Market demands and market varieties.

IX. Repressive agencies.
1. Diseases of the peach.
a. Kinds.
(1) Those of parasitic origin.
(2) Those of non-parasitic origin.
b. Remedies.
2. Animal enemies, insects, etc.
a. Kinds.
b. Preventive measures.

X. Uses of the peach.
1. As food: fresh, dried, and canned.
a. Food value. (Composition.)
b. Culinary usefulness of the peach.

D. The Grape

I. Botanical relations.

II. History.
1. Antiquity.
2. Native species. The European grape.
3. Geographical distribution.
a. General throughout the world.
b. Throughout the United States.
c. In California.
4. Rise and progress of the grape industry in California. The three chief divisions of California grape culture: grapes for the table, for raisins, and for wine. The grape crop of California.

III. Soil.
1. Soil ingredients removed by grapes.
2. Soils for grape growing.

3. Unfavorable soils: with excess of water; alkali soils.
4. Improvement of soils. Cover crops, etc.

IV. Propagation.
1. Growing vines from seeds.
2. Growing vines from layering.
3. Growing vines from cuttings. Eye cuttings, longer cuttings.
    a. Making and caring for cuttings.
    b. Rooting cuttings in nursery.
4. Budding and grafting the grape vine.
    a. Grafting the old stump.
    b. Side grafting.
    c. Herbaceous grafting.
    d. Grafting on resistant roots. The cutting graft.
    e. Time of grafting.
    f. Care of the scions.

V. Cultural methods: care of vineyard.
1. Vineyard practice.
    a. Laying out the vineyard.
    b. Distances of planting.
    c. Number of vines to the acre.
    d. Staking. Trellises for Eastern grapes.
    e. Avenues in the vineyard.
2. Planting.
    a. Planting cuttings and rooted vines.
    b. Planting long cuttings.
    c. When to plant.
3. Cultivation of vineyard.
4. Irrigation.
5. Pruning.
    a. Pruning tools.
    b. Time for pruning.
    c. Kinds of pruning.

- *d*. The first winter pruning; second year, third year, and fourth year's pruning.
- *e*. Subsequent pruning.
- *f*. The Chaintre system.
- *g*. Summer pruning and suckering.

VI. Repressive agencies in grape culture.

1. Diseases.
   - *a*. Fungous.
   - *b*. Physiological.
2. Insect enemies.
3. Methods of combating diseases and insect pests.

VII. Varieties.

1. Foreign varieties introduced into California.
   Varieties adapted to: —
   - *a*. Central coast valleys.
   - *b*. Sacramento Valley and foothills.
   - *c*. San Joaquin Valley and foothills.
   - *d*. Southern California.
2. Eastern varieties grown in California.
3. Wine grapes grown in California.
4. Raisin grapes grown in California.

VIII. Harvesting, packing, and shipping of fresh grapes.

1. Harvesting.
   - *a*. Time of harvesting.
   - *b*. Picking.
     - (1) Clippers, crates, etc.
2. Packing.
   - *a*. Grading.
   - *b*. Size of packages.
   - *c*. Trade marks.
3. Shipping.
   - *a*. Private trade.
   - *b*. The commission merchant.
   - *c*. Associations.
   - *d*. Loading cars for shipment.

IX. Raisin grapes.
  1. Making of raisins.
    a. Picking. Time ascertained by color, taste, or saccharometer.
      Methods of picking. Trays.
    b. Drying.
    c. The "sweat box."
    d. Sorting and grading.
    e. Equalizing.
    f. Packing.
  2. Marketing raisins.
    a. Commission packers.
    b. Associations.

E

Semi-tropical fruits: the olive, fig, orange, pomelo, lemon, date, and minor semi-tropical fruits grown in California. Studied according to outlines similar to those for other orchard fruits.

F. Small Fruits

The blackberry is fully outlined for study as an example of small fruits. The loganberry, raspberry, strawberry, and other small fruits may be studied, following similar outlines.

The Blackberry

(The same outline may be used for the dewberry.)

I. Botanical relations.
II. History.
  1. Distribution as a wild berry through the United States.
  2. Noted blackberry growing section of the United States.
III. Climate.
  1. Effect of climate upon fruiting.

IV. Soil.
   1. Soil best adapted to blackberries.
   2. Improvement of blackberry soils.
   3. Use of fertilizers. Manures, etc.

V. Propagation.
   1. By suckers.
   2. By root cuttings.

VI. Cultural methods.
   1. Planting. Time. Methods.
   2. Cultivation.
   3. Mulching.
   4. Irrigation.
   5. Pruning.
   6. Training and trellising. (Necessary for dewberries especially.)

VII. Harvesting and marketing.
   1. Time to pick.
   2. Picking receptacles.
   3. Berry packages.
   4. Shipping.

VIII. Repressive agencies.
   1. Animals, birds, insects. (Root borer, cane borer, etc.)
   2. Plant diseases.
   3. Fungous diseases.

IX. Varieties.
   1. Most popular varieties in California.
   2. New and improved California varieties.

G. Nuts

Study in detail the culture and marketing of nuts of local importance.

H. Fruit Canning, Crystallizing, and Drying

General lectures on —

I. The canning industry in the United States and especially in California.

II. Crystallized fruits.

III. The dried fruit industry in the United States, with especial regard to California. General discussion of trays for drying, protection from rain or dew, drying floors, grading, cutting sheds, sulphuring, cleaning, sweating, dipping, and packing. Discussion of special methods for various fruits may be given as the fruits are studied.

I. Repressive Agencies

General lectures on repressive agencies in fruit growing or drying, not treated under the various fruits.

I. Injurious insects. General discussion of ways and means for suppression of orchard and vineyard pests. Disinfecting nursery stock.

II. Diseases caused by fungi and bacteria. Abnormal conditions, causes not clear.

III. Suppression of injurious animals and birds.

IV. Protection from winds and frosts.

J. Harvesting and Marketing Fruit

General lectures. Omit all points already treated under the various fruits, — or merely sum them up.

I. The fruit market.

a. The two markets.

(1) Wholesale — General.

(2) Retail — Special.

b. Commission men.

c. Selling associations.

d. The home market.

e. Considerations affecting demand for and prices of fruits: oversupply, quality, season, acquaintanceship of buyers with the fruit, supply of other fruits, also price as affecting demand.

f. Utilization of wastes.

II. Picking.

Time. Picking receptacles. Fruit-picking tools. Managing pickers.

III. Sorting and grading of fruit. Designation of grades, etc.

IV. The fruit package.

a. Characteristics of the American fruit package.

b. Standard packages for various fruits.

V. The coöperative fruit marketing associations of California: their character, objects, and conditions leading to their organization.

K. Olericulture — Vegetable Gardening

I. Definitions. What is vegetable gardening? The geography of vegetable gardening.

II. The two classes of vegetable gardening: growing for home use and growing for market.

III. Vegetable gardening soils. Soil improvement. Tillage.

IV. Vegetable gardening tools.

V. Vegetable gardening seeds and seed selection. Sowing of seeds, growing of seeds.

VI. Management of the vegetable garden. Transplanting.

Irrigation. Double cropping. Weeds, insects, and plant diseases.

VII. Classification of the vegetable gardening crops. Study of the more important vegetable gardening crops of the region in which the school is located.

VIII. Marketing and storing vegetables.

IX. Garden work. Individual student garden work accompanies the work of this part of the course.

L. LANDSCAPE GARDENING

I. Study of the elementary principles of landscape gardening. Assigned problems in making planting plans for town lots and country homes.

II. Elementary work in floriculture. Study of a few common flowers; planning of flower beds, window gardens, etc. Floriculture in connection with landscape gardening and home grounds improvement.

PRACTICUMS

1. Outline concisely but completely work in vegetable gardening which may fittingly be given as a part of a year's course in horticulture in the high school. State time to be given to this work.

2. Outline, day by day, two weeks' instruction covering any chosen phase of a year's work in horticulture for the high school. Summarize lectures, note reading or other assignments, and give full directions for laboratory work or other practicums which are to be undertaken in connection with the instruction.

REFERENCES FOR COLLATERAL READING

Course in Agriculture for the High Schools of Michigan, Michigan Agricultural College, Department of Agricultural Education, Bul. 7. 1911. pp. 29–37.

PALMER, C. F. Elementary Horticulture for California Schools. Los Angeles, Cal., Normal School Bulletin. 1910.

WATTS, R. L. Field Laboratory Work accompanying College Courses in Horticulture. National Education Association. Proceedings. 1910. pp. 1082–1087.

CHAPTER XI

FOURTH YEAR AGRICULTURE: FARM MECHANICS AND FARM BUILDINGS; FARM MANAGEMENT

It is assumed that during the first three years of the high school agricultural course opportunity is given students to acquire a good basic knowledge of farm plants and animals and their production. They may also gain an understanding of the carrying on of one or more farm industries, such as dairying. That is, the studies of these years deal very largely with the basic principles of farming, and with farm practice. The agricultural studies of the last high school year are more concerned with the proper equipping of a farm and with the carrying on of farming as a business; that is, the work is divided between two phases of work, that dealing with rural engineering, farm mechanics, or farm equipment, and that dealing with the economic problems of farming.

During the year students should be given an opportunity to learn as much as possible of the machinery which is used in the care and production of plants and animals and in doing the work of the farm, and of the relation between efficiency in tools and machines and the yields and profits of a farm. They should study the

planning, grouping, and construction of farm buildings in the most efficient, sanitary, convenient, and economical way. They should study the general management of the farm, its layout, equipment for different kinds of farming, systems of farming, the keeping of records and accounts, and all those things which make for efficiency in conducting farm operations as a business. During the last year there should be, too, some consideration of the social as well as economic problems of rural life and of means for their solution.

In order, the study of the rural engineering topics selected should precede that of the rural economics problems, — the first half of the year being given to rural engineering, while the last half is given to rural economics. This is because an understanding of the fundamental problems of rural economics necessitates a previous study and understanding of both farm practice and farm equipment. To manage a farm in the most efficient way, the farmer must have a thorough knowledge of equipment as well as of methods of raising crops and live stock.

The materials of both rural engineering and rural economics are widely varied. Each includes a vast number of topics, and each is known to agricultural teachers under several names, as rural economy, agricultural economics, agricultural engineering, farm economics, and farm organization.

Where, a few years ago, the agricultural colleges were content with offering a single course along each line, they are now giving a number of courses, the nomenclature and materials of which vary widely. Names applied to but a single division of the subject in one school are in another school applied to an entire group of studies. Farm management, for example, though now considered by the majority of agricultural teachers to include, properly, but a single phase of the problems of rural economics, is in some schools made to include all those studies which are elsewhere grouped under the general term of rural economics. While in one school farm mechanics may mean only a study of farm machinery and its care and repair, in another school the term may be made to include not only the study of farm machinery and farm power, but also of blacksmithing, carpentry, farm architecture, and even of drainage, irrigation, and road construction. There is, therefore, much confusion in understanding of the names applied to these studies and great diversity as to the materials included in each in the different schools and colleges.

While in the high schools only the more elementary principles and basic topics of each line of study can possibly be taken up and covered, yet here, as in the colleges and special agricultural schools, there is a wide diversity in the topics chosen for study and in the names given to the courses. In some high schools all the rural engineer-

ing topics selected for study are given under the name farm equipment, in others as farm mechanics, or farm machinery. In other schools this work is split up into separate courses in farm machinery, farm carpentry, farm power, and farm buildings. In a similar fashion, while the study of the rural economics topics chosen is in one school called farm management, in another it may be called farm relations and farm management, or agricultural economics; or the work may be split up into special courses in farm accounts, farm management, etc. In still other schools the name farm management is made to include all the topics taught during the last year, in both rural engineering and rural economics. In fact, this last is a very popular nomenclature, though it is contrary to the understanding of the term farm management which is now being urged by agriculturists.

In the materials chosen for study in the high school from each of these two great fields there is a diversity as wide in different schools as the diversity in the names of the courses; and only too frequently the materials are but poorly related to the name. Indeed, there may be said to be almost no uniformity in materials and no general understanding of just what work should be included in high school instruction along either line. There are almost as many different outlines of work used as there are schools attempting the work. And, in the same school, the outlines followed change with every

change of teacher and even from year to year with the same teacher, for very vague reasons. The course should, everywhere, be more or less elastic, to be sure; but there should not be such radical differences in the work presented as at present exist.

Greater definiteness in the general outlines of the work covered is a crying need, as is also a better adaptation of the subject matter chosen to high school work and of the names of the courses to the subject matter. There should be a more earnest endeavor to determine the real educational and practical value of materials in each line of work and to choose the essential principles and facts for presentation to high school pupils.

In rural engineering the essential subjects seem, for high school students, to be farm machinery, farm power, and farm architecture. Farm drainage and irrigation are rural engineering topics, but have already been considered more or less in first year agriculture and in connection with the production of different crops. Time is limited, and they must therefore for the most part be omitted from the fourth year work, though they will be considered more or less in farm management in planning the outlay of farms. Those phases of the study of rural roads belonging to the rural engineering work must also be somewhat slighted, because of the short time available for the work. Yet some time should be given to lectures and reading assignments on road construction. In addi-

tion, roads will be considered from another viewpoint, — that of their effect on marketing and on the value of property, — in the farm management or rural economics work.

As to the naming of the course, while all the work of the first semester comes, as has been said, under the general term of rural engineering, yet this seems too pretentious a term for high school use. Farm mechanics seems for this reason to be a better nomenclature. Yet many object to this, saying that it is not commonly understood to include the subject of farm buildings, — which is an important phase of this work in high school. It is therefore suggested that the work of the first semester be called farm mechanics and farm buildings, or farm mechanics, including farm buildings, for the sake of clearness, definiteness, and simplicity.

In the rural economics work of the last semester, nomenclature and materials differ as widely as in the rural engineering work, as has been indicated. In some schools different materials are studied under the same name; in other schools practically the same topics are studied, but under different names. Here, too, we need greater definiteness and uniformity.

In this connection the 1911 report of the Committee on Instruction in Agriculture, of the Association of American Agricultural Colleges and Experiment Stations, which deals largely with the nomenclature of the subjects

grouped under rural economics, is interesting. After referring to the 1896 report of the Committee, in which the general policy of farm management, rural law, agricultural bookkeeping, and all topics related to the economics of agriculture are grouped under the general heading of rural economy or farm management, the report goes on to state that there should be a clearer understanding of the meaning of these terms and their relations to each other. While fifteen years ago the terms were synonymously used, the general consensus of opinion among agricultural educators of to-day is that this is incorrect. While it is considered that the name rural economics is applicable to the entire field of economics in its relation to agriculture and rural communities, it is thought that the term farm management should be restricted to that phase of rural economics which deals with the business organization and direction of individual farm enterprises.

According to the opinion of President Butterfield, of the Massachusetts Agricultural College, accepted by the American Farm Management Association, the entire subject of rural economics is properly divided into three phases: —

"The business aspect; farm administration or farm management. How can the individual farmer so organize the factors of production, — land, labor, and capital, — on his farm, so adapt farm practice to his

particular environments, and so dispose of his produce as to yield him the largest net return, while still maintaining the integrity of his land and equipment?

"The industrial aspect; agricultural economics. How can the farmers as a class secure the largest financial success, while giving to the consumers an adequate food supply and maintaining the soil resources? How adjust systems of land tenure, means of transportation, methods of marketing, systems of taxation, institutions of credit, and protective and stimulating legislation to the legitimate needs of the farming class?

"The community aspect; rural sociology. How can the people who farm best utilize their industrial and social environment in the development of personal character, best coöperate for their common welfare, minister to the continued improvement of the common or community life? How best organize the personal and community resources of the rural people for the purpose of contributing most fully to national welfare?"[1]

Director L. H. Bailey, of the College of Agriculture of Cornell University, says that his idea is that "Farm management has to do with the business organization and direction of the farm; rural economics . . . has to do with the relation of the farm to the community."

Dean Price, of Ohio State University, states that in his

[1] Report of the Committee on Instruction in Agriculture, 1911. Office of Experiment Stations Cir. 115, pp. 4–5.

classification he has used rural economics as a generic term including farm management, agricultural economics, rural sociology, and comparative and historical agriculture. "Between agricultural economics and farm management I have made the distinction that farm management is a study of the economics of agriculture from the standpoint of the individual, and that agricultural economics is a study of the industry in its relation to other industries from the standpoint of society as a whole. . . . While it will be necessary to separate farm management from agricultural economics as the work is developed, it seems to me that they are both closely related and that rural economy can well be used as a generic term to include both of them."

Professor F. D. Gardner, of the Pennsylvania State College, says: "To my mind, farm management deals with the farm as a unit, while rural economy deals with the aspects of the farm and the farmer which have a community interest and which affect a community as a whole.

"Farm management should be based on the subjects of agronomy, horticulture, animal husbandry, dairy husbandry, agricultural engineering, and the sciences and practices that underlie these subjects. As taught to the student, it should follow and be based on his knowledge of these subjects. It is the culmination of his technical studies in agriculture, bringing them together

and applying them to the problems of the farm and its administration. . . .

"Farm management deals with the administration of the farm as a unit so as to produce the maximum profit from land, labor, capital, goods, and managerial activity at hand. It deals with the layout of the farm, with the extent and general character of improvements and buildings, but leaves the survey of the farm and the construction of the buildings to agricultural engineering. It considers the rotation of crops in relation to the maintenance of soil fertility, the acreage of crops in relation to the economical use of labor and equipment. It considers the number of the various classes of animals that can best be maintained and whether concentrates shall be grown on the farm or whether they may be most economically purchased from outside sources.

"How to operate and care for farm machinery belongs to the field of agricultural engineering, but the duties of machinery, how many machines of various kinds will be required, or whether the farmer should own a self-binder or should rent one, are problems belonging to farm management. Land rentals, relation of landlord to tenant, forms of leases, the employment of labor, its management, responsibility, and liabilities, are problems of farm management.

"Farm management also deals with markets and marketing, with transportation facilities, and with coöperation.

These, however, may go so far as to become community enterprises and be equally as much the problems of rural economics. Legal forms, farm records, and farm accounts also belong to the field of farm management.

"The line of cleavage separating farm management from rural economics may not be sharply defined. The line inclosing and separating one from the other will be a series of projections and recessions dovetailing together as the cogs of one pinion dovetail with those of its companion."

The general opinion, then, seems to be that the name rural economics should properly be given to the entire group of studies which deals with economic problems in agriculture as distinguished from the farm practice subjects and rural engineering; and that under that general name comes farm management, the study of rural sociology, and related topics.

In a brief high school course it is evident that but a few of the topics classed under rural economics can be studied. Yet it is equally evident that these should not be confined within too narrow limits, but should include some consideration of rural social problems and the relation of farming communities and the state as well as a study of the business administration of individual farms. For these reasons it might perhaps be well to choose the broad term rural economics for the work. However, this seems, as does rural engineering,

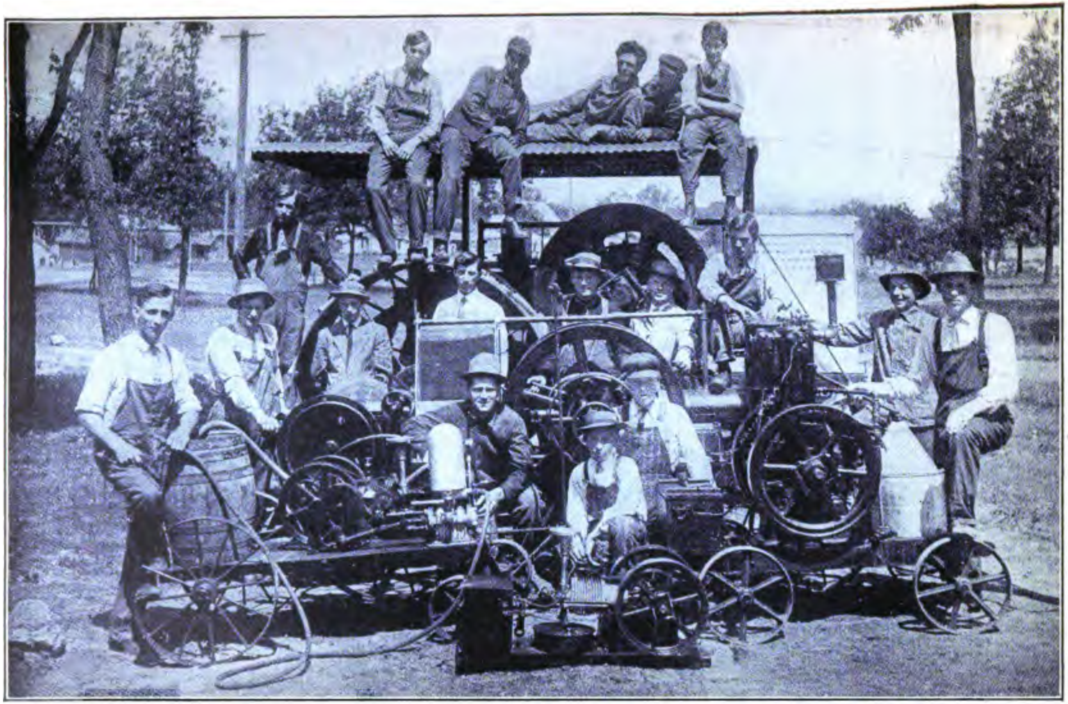
a somewhat pretentious term for the kind of work which can be given in the high school; and, too, the work will, obviously, not be evenly balanced along all these lines. For the high school student, in the brief time at command, the problems of the farm as a unit must be emphasized, rather than those of the community. Instruction must be practical, rather than theoretical. Only the more immediate and pressing economic and social problems of the community as a whole can be taken up. For this reason it is argued by some that the name farm management should be given to the work in the high school, since it is the business aspect in the administration of a single farm that is emphasized; and this is the name that is most used. Whether it will continue to be used, or will be discarded for the more general term, the future must tell.

The farm mechanics and farm buildings work of the first semester of the fourth year may well be divided about evenly between the two subjects. Each should provide for a large amount of practice work and for that reason should be assigned two periods daily for the time given. Of this time one day per week will probably prove sufficient for the lecture and recitation work, the rest of the time being divided among indoor laboratory, shop, and outdoor work as needed. The recitation time may, if desired, be divided, — one period being used say Tuesdays and another Thursdays for lecture and reci-

tations, — instead of having a double recitation period one day per week.

In farm mechanics the student should acquire a knowledge of the tools and machinery that are used upon the ordinary farm or sold by local dealers, — their kinds, uses, special adaptations, cost, housing, and care. Many of these machines and tools will already have been used and studied more or less in connection with the work in preceding courses; but only as aids in production. In this course they are studied from a somewhat different standpoint, and their construction, efficiency, cost, care, and housing are emphasized. Though the previous study of machines and implements has been largely incidental, the knowledge of the kinds, uses, and special adaptations thus acquired will be found to be of great advantage here, materially shortening the time which it is necessary to give to the different implements and machines in this course.

Following the study of farm tools and machines, some time must be given to the study of the sources of farm power, the advantages and disadvantages, efficiency, cost, and special uses of each. Particular attention should be paid to the gasoline engine because of its growing importance as a source of farm power and the multitude of ways in which it can be utilized. Students should have practice in running and caring for gasoline engines. Common gasoline engine troubles should be



Studying the Gasoline Engine, La Crosse County School of Agriculture, Onalaska (Wis.).

called to their attention and means of remedying them learned.

The subjects of farm drainage and irrigation have been studied in an elementary way during the second semester of the first high school year, if the outline suggested in Chapter VI is followed. The same subjects also come up in connection with the study of the culture of various crops. Students are therefore supposed to have a certain familiarity with leveling and surveying instruments by this time, and with basic facts as to farm drainage and irrigation. But it is also extremely desirable that this knowledge be increased during the fourth high school year, and that some practice in farm surveying and in the use of leveling instruments be given.

If possible, the farm mechanics work should also include very elementary instruction in blacksmithing, horseshoeing, and the like. The student should learn to construct or repair simple parts of machines and implements used on the farm and to make simple farm appliances. Many farm appliances should, however, have already been made by students if they have had a previous special course in manual training, in that course.

It should be said here that it is desirable, if not imperative, that students should have as a preliminary to this work some instruction in manual training (including

wood shop and forge) and in mechanical drawing. One semester of each would doubtless prove an excellent basis for the work in both farm mechanics and farm buildings, though more would of course be advantageous. Where it is not possible to give such preparatory work, elementary instruction along these lines must accompany the special work in farm mechanics and farm buildings.

In farm buildings the location, planning, grouping, and construction of the farm house, barns, and other outbuildings should be studied, as also the farm water supply, the sewage disposal system, and the lighting of farm buildings. Materials used in construction — as wood, stone, brick, and concrete — should be studied and compared. The cost of materials and of labor for the building of given structures should be estimated.

In this course, too, farm fences should be studied, as to the different purposes for which used, materials and construction, cost and efficiency.

There is no textbook really suitable for high school work in farm mechanics, though Davidson and Chase's "Farm Machinery and Farm Motors" covers one phase of the subject admirably. However, it includes far too much material for use in a brief course such as that described. Furthermore, it does not provide for any practicum work, which should form so important a part of the farm mechanics work in the high school. There should, however, be several copies of the book in

the library, and students should be referred to it frequently. King's "Physics of Agriculture" will also be much used in this work, and it may be well for members of the class to purchase either this or Davidson and Chase.

For the work in mechanical drawing, where this is not taught separately, such texts as Anthony's "Elements of Mechanical Drawing" or Tracy's "Introductory Course in Mechanical Drawing" will be found helpful.

Members of the class should also secure some of the more important of the numerous government bulletins on farm machinery, and parts of them should be studied by the class. Among these the following farmers' bulletins may well be included: No. 95, "Good Roads for Farmers"; No. 136, "Earth Roads"; No. 179, "Horseshoeing"; No. 277, "The Use of Alcohol and Gasoline in Farm Engines"; No. 303, "Corn-harvesting Machinery"; No. 321, "The Use of the Split-log Drag on Earth Roads"; No. 338, "Macadam Roads"; No. 347, "The Repair of Farm Equipment"; No. 403, "The Construction of Concrete Fence Posts"; and No. 505, "Benefits of Improved Roads." In addition, numerous state experiment station publications on farm machinery will be found helpful.

Lectures and reading assignments should cover the various classes of farm machinery and farm motors, the more important kinds of each class, and their cost,

efficiency, care, and repair. They should also include something as to the value of good farm roads and bridges, their kinds and construction.

In farm buildings a text may or may not be used. It will probably be well, however, to have students purchase some one book, such as Roberts' "Farmstead," Powell's "Farm Plans and Buildings," or the book on "Farm Buildings" published by the Sanders Publishing Company.

In addition, there are many valuable government and state bulletins on the planning and construction of all kinds of farm buildings, to suit different conditions. These should not only be secured for the library, but students should be encouraged to collect as many of them as possible for their own reference and use.

The lectures may well summarize for pupils the essential factors to be considered in the location of farm buildings and in the planning and construction of the different buildings needed on the farm.

As practicum work in farm mechanics there should be trips to farms of the community to note the different kinds of implements and machines used on local farms and to observe methods of storing and caring for them. Agricultural implement houses should be visited and the stock and prices studied. Any implement new to the community should be studied in the field and on the farms of users.

There should be practice in setting up farm machinery. In connection with this phase of the work it may be possible to arrange with local dealers so that the class may see various implements unpacked from shipping cases and set up and adjusted for field use. They may even be allowed to take part in this work.

In the manual training work which should precede the work of this year students should have made many useful farm devices and appliances, such as corn-testing trays, chicken coops, butter-workers, feed boxes and troughs, models of bins for grains, milking stools, miter boxes, sawhorse, stable floor scraper, models of stanchions and ties, handles for tools, and so on. If there has been an opportunity to do any forge work, they should have had some practice in making chain links, drilling iron, and other simple problems.

If they have not had such work, as much time as can be spared must be given to it in connection with the special course in farm mechanics, and as a part of the practicum work in the courses dealing with the materials in connection with which these appliances are used. For example, where a considerable number of farm appliances are not made in a manual training course, required for agricultural students, various poultry appliances should be made in connection with the poultry work, dairy appliances in the dairy course, handy de-

vices used in connection with the care of live stock in the live stock course, and so on.

In any event, there should be on the school farm, if possible, a simple model farm shop, equipped with a bench, forge riveting hammers, rivets, nippers, staples, awls, punches of different sizes, jack plane, smoothing plane, ripsaw, crosscut saw, and other tools and materials needed in making simple repairs upon harness, machinery, and other farm equipment.

Here students should have practice in well-planned practical work. This should include any needed repairs in the school farm harness, tools and machines, and repairs of harness, implements, etc., brought in by students or farmers from their homes. The work done by students should not be indiscriminately selected and assigned by the instructor, however, but should, so far as is possible, give to each student practice in making a variety of useful repairs commonly needed. The aim should be to have each exercise have both educative and practical value. In cases where no harness or implements available need the particular kind of repairs which it is desired to illustrate, "sample" repairs may be made with worn-out harness, scraps of leather, wood, or parts of old machines.

Students should have practice either in this course or in a previous manual training course in drawing out round and square iron, in welding round and flat iron, forging

chain links and hooks, drilling cast and wrought iron and steel. The entire class should have practice in soldering, and, if possible, in setting up and babbitting a shaft. It is also desirable, if there is time, that some opportunity be given for elective work, such as making a butcher's knife or a saw set out of an old file, making a riveting hammer, chain hook, or other tools or construction needed upon the farm.

In addition to the individual exercises performed by members of the farm mechanics class, certain demonstration exercises will be found very profitable. In the demonstration work the instructor should not hesitate to secure assistance where possible from well-informed practical mechanics and farmers, or from the manual training teacher of the school. He himself is supposed to know more of the science and literature of his subject than others in the community and should himself give demonstrations of numbers of exercises. There is, however, a distinct advantage in having some demonstration exercises performed by local experts. For example, a good local blacksmith may be induced to make, in the school shop, several of the ordinary simple farm tools, such as are described in Cobleigh's "Handy Farm Devices," Holmstrom's "Modern Blacksmithing," and similar books.

Visits should be made to local blacksmith shops to observe the work of good horseshoers and to note methods

of doing various other kinds of work. Even when the work is of such a character that students do not expect to do it themselves, they should observe and become familiar with proper methods of making or repairing different farm tools and implements. They should understand the best methods in horseshoeing, even though they may never expect to shoe a horse themselves. It should, however, be impressed upon students that the more simple construction and repairs needed upon the farm should be actually done there, by the farm workers, wherever feasible, as a matter of economy, rather than taken to the town shops to be done. Days of inclement weather may be used to most profitable advantage in just such work. The loss in farm labor employed by the month or year will thus be greatly lessened, useful and pleasant occupation afforded mechanically inclined boys of the family, and money will be saved.

In arranging the practical work in farm mechanics, suggestions may be obtained from many publications. Among them, the New York State Education Department "Syllabus for Farm Mechanics and Drawing in Secondary Schools" should not be neglected; as also Michigan Agricultural College Department of Agricultural Education, Bulletin No. 7, "A Course in Agriculture for the High Schools of Michigan"; the Maine Department of Education "Course in Agriculture for High School"; and the Illinois Agricultural College Exten-

sion Bulletin on "How to run Farm Machinery." Suggestions may also be obtained from lists of exercises at the end of chapters on farm machinery in many of the general textbooks on agriculture.

Agricultural teachers in New York State high schools can secure sets of copies of mimeographed directions for several valuable farm mechanics exercises arranged for Cornell University students. Many of these are excellent for high school use as well, and it is possible that agricultural teachers outside of the state might also secure them.

In farm buildings the practicum work should include practice in reading tracings and blueprints of farm buildings rapidly, in criticizing plans intelligently, and later in the drawing of original plans and making blueprints from them. There should also be, accompanying the drawing of some of the original plans, the making of lists of needed materials, with estimates of cost of same, and specifications as to construction. Lastly, some actual construction work should be done by students, either in the making of frames for small model buildings or in work on buildings on the school grounds, or, preferably, both. In this course, too, models of different kinds of farm fences and gates should be made, or actual fence-building work may be done on the school farm.

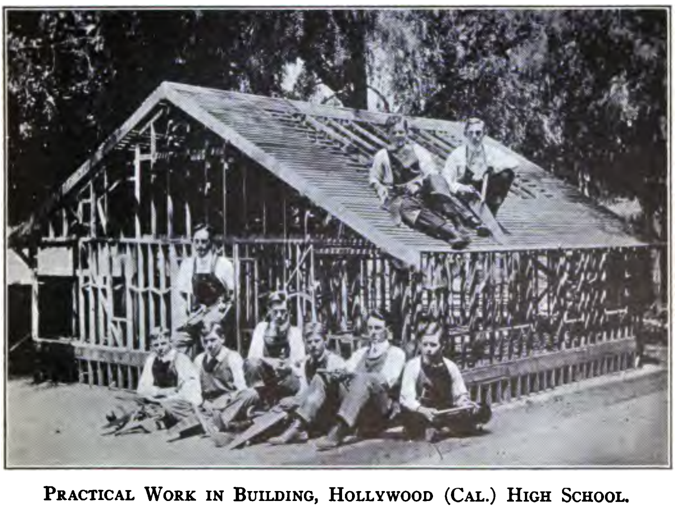
In some schools practically all the small buildings needed in the agricultural work are put up by agricul-

tural or manual training students. At the Gardena, California, high school not only are small buildings, such as lath-houses, put up entirely by students in farm mechanics and farm buildings classes, but when larger buildings, such as barns, are to be built, the school board furnishes one carpenter to each squad of four or five boys, and the boys assist in putting up the building under their direction and that of the class instructor. The boys thus have an opportunity actually to assist in putting up the building, under constant expert supervision, and when the boys are otherwise engaged in school work, the barn building goes on by the carpenters.

Visits should be made by the class to interesting houses and other buildings, especially farm buildings, in the course of construction, where different materials are being used or particularly desirable plans carried out.

In this course, too, interesting local surveys may be undertaken by individual students or groups of students, such as finding out the methods of sewage disposal in use on the farms within a given area and suggesting improvements for the various systems. Or a canvass may be made to determine the nature of the farm water supply within a given district, the distance of wells from outbuildings being noted in each case, the slope of the land with relation to the well, chances of contamination of well water by seepage from outbuildings, the method of distribution of the water supply to buildings, and so on.

MAKING A MINIATURE FARM BUILDING, LA CROSSE COUNTY SCHOOL OF AGRICULTURE, ONALASKA (WIS.).



PRACTICAL WORK IN BUILDING, HOLLYWOOD (CAL.) HIGH SCHOOL.

Students may make a plan for a farm water supply and sewage disposal system for some farm in the neighborhood, estimates may be obtained as to the cost of installing the system, including bathroom fixtures, kitchen sink, and possibly laundry tubs.

Much of this practicum work necessitates, evidently, a good beginning knowledge of mechanical drawing. In farm mechanics this is desirable; in farm buildings it is essential. If a special course in mechanical drawing is given in the school, it should be required as a pre-requisite to these courses. If no such course is given, instruction in mechanical drawing must accompany this work, though to take time for it now will, obviously, cripple the course to some extent. But before students can do properly the practical work in connection with farm buildings, they must learn the proper use and care of drawing instruments and how to make simple working drawings with accuracy and precision. They must acquire some knowledge of the more fundamental drafting conventions and rules of practice, and of the making of blueprints; and they should acquire a certain degree of facility in plain lettering.

The equipment for the course in farm mechanics and farm buildings should include a model farm shop, as mentioned above, equipped with tools and materials for the making of any ordinary repairs upon the farm. The size of this shop will, however, need to be larger than is

necessary on the average farm, and extra bench room and tools must be provided that individual students may have an opportunity to do all the practicum work outlined for them. The building may be of wood, though cement or brick is preferable; but that part of the shop floor about the forge and anvil should be of concrete, and it is preferable that this be used for the entire floor. It is desirable in many ways that the shop be in a building separate from the main high school building, though in climates where heat is necessary it should usually be near enough to be heated by the same system. If a separate building is unobtainable, a basement room may be fitted up for the farm mechanics shop, if of suitable size, with ready access to the outside of the building, and provided with a concrete floor and proper lighting. This is not advised, however, unless better arrangements are impossible. In case the shop is in the basement, the ceiling of the room must, obviously, be so prepared as to deaden the sound of the work being done in the shop, if classroom work is to be carried on with any comfort in the room above. In describing such a shop the New York State Syllabus says: "If the building has a gasoline engine or electric motor for ventilation, arrangements can often be made for extending its shaft or a counter shaft into the shop room, to be used for turning a grindstone, blowing the forge, or running a drill press or wooden lathe.

"Under the row of windows there should be a continuous bench, preferably built by the students, of two-inch planks. This bench ought to be about 30 inches wide and from 25 to 30 feet long. It should be provided at regular intervals with five wood vises, to be made by the class after the iron screws, sockets and handles are supplied. (See plan in Farmers' Bulletin 347, page 23.)

"At the end of the bench nearest the forge and anvil there should be a blacksmith's iron vise and near by a blacksmith's drill press. A good grindstone, mounted by the students, can be placed in a convenient corner, and vertical cabinets for the tools belonging to the school can be built by the first class from their own designs. Some open space should be reserved in the middle of the room for the use of sawhorses, for setting up work in the course of construction and for testing the operation of gasoline engines. The forge should be so placed as to exhaust the smoke and gases into the regular furnace stack.

"To deaden the sound of work being done in the shop, the ceiling of the room can be properly prepared, if desired, by the class in regular exercises. The under side of the floor joists overhead should be sheathed with 'deadening felt,' and this covered by a tight wooden ceiling or by lathing and plastering. Metallic ceiling should not be used because of its sound-conducting properties."

The ideal arrangement is probably a separate "farm shop" building, or a suitable room for this purpose in a separate manual training building. Here should be provided a suitable place for work and, either here or in an adjoining room, a space for exhibition and examination of machines, engines, and other implements which are at the time being studied, or which form part of a more or less permanent exhibit loaned by manufacturers.

The tools and machines on the school farm will be utilized in the study of farm machinery, but these will not suffice. Many others should be examined and studied by pupils, either on near-by farms, at implement houses, or in exhibits at the school, either for short periods or for an indefinite time. Farm implement houses are frequently glad to loan machines and tools for short periods (while the class is studying them) if they can be properly housed; and manufacturers of farm implements can sometimes be induced to loan machines or engines for indefinite periods for exhibition purposes. For example, when studying seeding machinery it may be possible to borrow a number of seeders from implement houses, showing seeders for different purposes and of different makes. These may be kept on exhibition at the school while the class is studying seeders, or until they have had an opportunity to become familiar with them, and then returned to the implement houses, when a new kind of implement is borrowed for exhibition and study.

When studying gasoline engines, too, it may be possible to borrow several engines from manufacturers, through local dealers, for study and even for experimental purposes; or it may be possible to secure loans of these same engines and machines for a permanent exhibit, if a proper place is provided for them. However, where engines are loaned by different firms, it is important that the teacher occupy a strictly neutral position as to favoring one engine more than another. After studying the construction of different types of engines and their use, students should be able to judge accurately for themselves as to different makes of engines.

In any event, whether the school is able to secure machines and engines for exhibit or not, the catalogues and books of directions of different firms should be secured and studied, and the engines compared by students. In addition, students should of course be given an opportunity to see as much as is practicable of the use of different machines, either on the school farm or on the farms of the community where they are owned.

Among other items useful in the equipment for a farm mechanics course, sectional models of gasoline engines will be found of great help, as also blueprints of such sectional models, if they can be obtained from the manufacturers. The needed instruments for farm surveying, including levels, rods, steel tape, range poles, etc., should also be available for use.

Collections of sets of blueprints for farm buildings, with photographs, will, if properly arranged, labeled, and catalogued, form a valuable part of the equipment. In addition, after one or two years, the illustrative value of the models of buildings made by previous classes will become apparent.

Drawing instruments and materials necessary for the work may be purchased by individual students or they may be bought by the school. In this case a laboratory fee may be charged for their use. They should include a set of drawing instruments for each member of the class, T squares, blueprint frames, drawing boards or desks (which may be made by the manual training students), 30°–60° triangles, and 45° triangles.

The library equipment should include the publications listed under agricultural engineering in Office of Experiment Stations Circular 94, "Free Publications of the Department of Agriculture Classified for the Use of Teachers," and other government publications on similar topics issued since the publication of this circular. Nor should the publications of other governments be neglected. Publications such as the New South Wales farmers' bulletins on "Blacksmithing for Farmers," "Harness, Harness Fitting and Repairing," and others of similar nature, may well be added to the library. A very large number of excellent bulletins and circulars have been issued by the various state experiment stations

Irrigation Well on the School Farm, Oxnard (Cal.) High School.

on the planning and construction of farm buildings, and a lesser number dealing with farm mechanics topics. Copies of the more important of these should be secured for the school, and in some cases it may be desirable to secure duplicate copies for members of the class. In addition to the agricultural experiment station publications the following special bulletins should also be secured: —

Cornell University Farm Mechanics Bulletin, "Knots and Hitches."

Cornell University Farmers' Reading Course Bulletins, Ser. 6, on Buildings and Yards.

University of Illinois Engineering Experiment Station Bul. No. 25, "Lighting Country Homes by Private Electric Plants."

University of Illinois Agricultural College Extension Bulletin, "How to run Farm Machinery."

Iowa State College Engineering Experiment Station Bul. v. 4, No. 6, "Sewage Disposal Plants for Private Houses."

Iowa State College Engineering Experiment Station Bul. v. 10, No. 1, "Electric Power on the Farm."

North Carolina State Board of Health Special Bul. No. 12, July, 1912, "Residential Sewage Disposal Plants."

Many publications of farm machinery and other manufacturing firms contain valuable material for the farm mechanics class, as, for example, the "Engine Operator's Guide," "Development of Agricultural Machines," and "Three Hundred Years of Farm Power" (issued by the International Harvester Company), "Concrete Construction about the Home and Farm"

(Atlas Portland Cement Company), and others. These, too, should be secured, though it should be remembered that they are written for advertising purposes and that they sometimes overemphasize the value of a particular machine.

Among magazines dealing more or less with farm mechanics topics the *Scientific American*, *Popular Mechanics*, and the *Patent Office Gazette* should be received at the school library regularly if possible. The school or class may subscribe for the first two, but the last can be obtained free of cost by application to the district congressman or one of the United States senators for the state.

The numbers of each periodical making a volume should be bound when complete, if the school can afford it. In any case they should be carefully preserved, and it is desirable that the more valuable material in them be indexed in the school library catalogue.

Among books, any of the following will be found useful in connection with the farm mechanics and farm buildings course.

American Portland Cement Manufacturers' Association. Concrete in the Country. Phil. Pub. by the Association. 1910.

ANTHONY, G. C. Elements of Mechanical Drawing. Bost. D. C. Heath & Co. 1904.

BASHORE, H. B. Sanitation of a Country House. N. Y. John Wiley & Sons. 1905.

COBLEIGH, R. Handy Farm Devices and How to make Them. N. Y. Orange Judd. 1909.

DAVIDSON, J. B., and CHASE, L. W. Farm Machinery and Farm Motors. N. Y. Orange Judd. 1908.

DODD, HELEN. The Healthful Farmhouse. Bost. Whitcomb & Barrows. 1911.

DREW, J. M. Farm Blacksmithing. St. Paul, Minn. Webb Pub. Co. 1907.

ELLIOT, C. G. Practical Farm Drainage. N. Y. John Wiley & Sons. 1908.

Farm Buildings. Chic. Sanders Pub. Co. 1905.

FOSTER, E. W. Elementary Woodworking. Bost. Ginn & Co. 1904.

GOSS, W. F. M. Benchwork in Wood. Peoria, Ill. Manual Arts Press. 1912.

GRIFFITH, I. S. Correlated Courses in Woodwork and Mechanical Drawing. Peoria, Ill. Manual Arts Press. 1912.

GRIFFITH, I. S. Essentials in Woodworking. Peoria, Ill. Manual Arts Press. 1912.

GRIMSHAW, R. Saw Filing. N. Y. Norman W. Henley Pub. Co. 1912.

HALSTED, B. D. Farm Conveniences. N. Y. Orange Judd. 1906.

HODGSON, F. T., ed. Modern Carpentry. Chic. F. J. Drake & Co. 1907.

HOLMSTROM, J. G. Modern Blacksmithing. Chic. F. J. Drake & Co. 1904.

HOLSTROM, J. G. Standard Blacksmithing. St. Paul, Minn. Webb Pub. Co. 1907.

KING, F. H. Irrigation and Drainage. N. Y. Macm. 1908.

KING, F. H. Physics of Agriculture. Madison, Wis. F. H. King. 1907.

LYNDE, C. J. Home Water Works: a Manual of Water Supply in Country Homes. N. Y. Sturgis & Walton. 1911.

MARTIN, G. A. Farm Appliances. N. Y. Orange Judd. 1907.
MARTIN, G. A. Fences, Gates, and Bridges. N. Y. Orange Judd. 1887.
MATHEWSON, F. E., and STEWART, J. L. Applied Mechanical Drawing for First and Second Year Classes in High School. Springfield, Mass. Taylor-Holden Co. 1911.
OGDEN, H. N. Rural Hygiene. N. Y. Macm. 1911.
POWELL, F. E. Small Dynamos and Motors. N. Y. Spon & Chamberlain. 1910.
POWELL, E. P. The Country Home. N. Y. McClure, Phillips & Co. 1904.
PUTNAM, X. W. The Gasoline Engine on the Farm. N. Y. Norman W. Henley Pub. Co. 1913.
REED, S. B. Modern House Plans for Everybody. N. Y. Orange Judd. 1900.
ROBERTS, I. P. The Farmstead. N. Y. Macm. 1907.
TRACY, J. C. Introductory Course in Mechanical Drawing. N. Y. Harper. 1898.
VERRILL, A. H. Knots, Splices, and Rope Work. N. Y. Norman W. Henley Pub. Co. 1912.

The community work which may be done in connection with farm mechanics and farm buildings is varied. Illustrated lectures will be found especially interesting and helpful. Fortunately it will not be necessary for the teacher to prepare all these for himself. Excellent illustrated farmers' institute lectures on farm buildings and farm mechanics have been published by the Office of Experiment Stations, and slides to accompany them may be borrowed. Those so far issued are: No. 5, on "Silo Construction"; No. 7, "Roads and Road-build-

ing"; No. 8, on "Farm Architecture"; and No. 12, on "Farm Homes." Photographs and slides may also be secured from departments of agricultural implement manufacturing companies, such as the International Harvester Service Bureau, for use in illustrated talks.

As a part of the community work plowing contests may be held; short courses in farm repair work may be given; plans may be made for sewage disposal systems. Farmers' and farmers' wives' institutes may be held for the discussion of problems relating to the farm home, farm home conveniences, and related topics.

More and more interest is being taken in such topics as these, and country people are ready and eager for helpful suggestions.

Following the farm mechanics and farm buildings work of the first semester of the fourth high school year should come, as has been said, the study of some of the more important problems of rural economics, especially those relating to farm management. It is not enough that the agricultural student should have learned something as to farm equipment and its care, or that he should understand the basic principles of plant and animal production. He must know, not only how to raise good crops and stock, but how to raise them economically. He must not only be able to raise them economically, but he must understand how to market them wisely. That is, he must know how to manage

the work of the farm in such a way as to produce the maximum profit from the land, labor, and capital invested.

We are coming to realize more and more that successful farming is not dependent merely upon a knowledge of plants, animals, and of soils; of how and when to sow and cultivate and irrigate. All this must be accompanied by an understanding and application of business methods. The application of science in production must go hand in hand with the application of the principles of scientific management if the farm is to pay as it should. The person who engages in farming as an occupation must make of it a business. He must understand how to select a farm to suit the kind of farming to be carried on; how to arrange his fields systematically; how to estimate accurately the cost of growing different crops and their net profit to him; how to carry on his field operations in the most economical as well as the most effective way; and how to market his crops most profitably.

The work of the rural economics or farm management course should include, then, a study of how to choose a farm; the factors affecting the economic value of a farm; the advantages and disadvantages of various landholding systems, as ownership and rental, share and cash tenantry; the kinds of farming; principles and systems of crop rotation; considerations involved

in making a farm layout plan; the keeping of farm records and accounts; and the marketing of farm products. Students should become familiar with the ordinary business forms and should have some instruction as to laws and legal forms of particular interest to farmers. Lastly, some attention should be given to the more important problems of rural social life, farmers' organizations, coöperation of farmers for various purposes, rural sports and recreations, and similar topics.

One daily period (of about forty-five minutes) throughout the semester will probably prove sufficient for the course, except that on one day per week there should be a double period for practicum work.

Because of the lack of a suitable high school textbook in rural economy, or farm management, the work must, for the most part, be presented to students in lecture form and as reading assignments. Hunt's "How to Choose a Farm," Card's "Farm Management," Warren's "Farm Management," and parts of volumes one and four of Bailey's "Cyclopedia of American Agriculture" will perhaps be the most useful books for the course, though Carver's "Principles of Rural Economics" and Taylor's "Agricultural Economics" will undoubtedly be frequently referred to.

The lectures should cover the topics outlined for the course in logical order and in a simple, clear, and definite way, suited to the comprehension of pupils. The essen-

tials in farm management should be emphasized, and each topic should be discussed with reference to local conditions. Talks to students by successful farmers of the community on the business side of different kinds of farming and on the ways in which they have, individually, worked out farm management problems, should also be of advantage if they can be arranged for.

The practicum work should be very carefully outlined by the instructor and related as closely as possible to the lecture and reading assignment work. A wide range of exercises is made possible by the nature of the work, but care should be taken that those selected are of practical value.

They may include the drawing of the home farm, or of any given farm, to a scale, showing the present arrangement of fields, yards, and buildings in the "home" plot, of orchards, gardens, etc., and suggesting any possible improvements. Model plans for the layout of fields and an irrigation system for given farms may be made. Problems dealing with the cost of different crops, their value, and the net profit derived from them may be worked out. Excursions should be made to score farms, — to indicate the economic value of farms, — using some good score card, such as that used at Cornell.

A large number of interesting problems deal with the difference in the amount of labor it is necessary to do

in caring for crops on a given farm where fields, yards, and buildings are poorly located, and the same farm when they are properly located. Among these are exercises to determine the most desirable shape and size of fields for economy in plowing and for harvesting certain crops; exercises relating to the arrangement of the farm in such a way as to secure the greatest economy in hauling crops and manure and in going to and from work; exercises to show how to secure the greatest economy in fencing; and many others.

All students should enter a set of farm accounts for a part of a year and balance the books. They should make out sample bills of goods, receipts, a contract with a hired man, a lease, and similar business forms.

Among the individual or home projects which may be attempted are: making an inventory of all the property on the home farm, not including household articles; estimating what per cent of the capital is in real estate; what per cent in machinery; in live stock; and in other important items. Or individual students may keep an account with chickens, horses, garden, or some crop, and determine the profit or loss. Another good problem is to have each student assume that he has a definite amount of wheat, oats, hay, potatoes, etc. By consulting the market reports for a stated market in a reliable agricultural paper, he is to determine the best time to

sell his products, everything to be disposed of at a given time.

As a thesis or term problem, each student may, if desired, take some one farm and work out for it a scientific scheme of management. Such a farm problem corresponds, as has well been said, "to the plans and specifications and financial estimates that an architect makes for a building." In solving it the student is expected to apply all that he has learned of the practice of agriculture to the making of an ideal scheme of management for a particular farm. In writing up such a problem a full description of the farm in question should first be given, including location, size, fields, soils, previous crops, buildings, fences, roads, markets, etc. An inventory of the property on the farm or a list of needed equipment should then follow and a proposed scheme of management for three or more years.

Excellent directions for working out such a farm problem as this are given in Warren and Livermore's "Laboratory Exercises in Farm Management," though, since this is a manual intended for college students, it may be wise to modify the exercise somewhat for high school pupils.

In making out the list of exercises for the farm management work this book should by all means be consulted, for in it are given a large number of excellent exercises. Some of them may be too difficult for high school pupils,

but many of them can very well be used. The fact that the exercises are arranged by subjects and that an excellent list of references to books and bulletins, similarly arranged, is also given, makes the book especially valuable to the farm management teacher.

In addition to the regular farm management work it would be well, during this last semester of the high school course, to arrange for an "agricultural news hour" at least once every two weeks. If no other time can be arranged, an hour of the farm management recitation periods might be taken for it.

At this time new agricultural publications of interest, published by the government, experiment stations, state boards of agriculture, agricultural associations and societies, or by individuals, should be brought to the attention of pupils and each briefly discussed. Wherever possible the publications themselves should be at hand and should be put upon a "reserve" or "exhibit" shelf or table in the school library for a definite period, so that students may inspect them. By this means students will become aware of sources of agricultural literature of which they may not have known before; important publications of which they would probably not hear, otherwise, are called to their attention; and they are shown the need, on the part of the progressive farmer, of being "up-to-date" in acquaintance with printed agricultural information.

The equipment for farm management should include drawing materials, as for the first half year course, maps of farms to a scale, if they can be secured, sample farm records and accounts, farm score cards, and a good collection of books and bulletins.

The bulletins listed in Office of Experiment Stations Circular 94 under agricultural economics should by all means be secured, together with as many of the experiment station publications as promise to be useful in connection with the course. The recent Bureau of Plant Industry Bulletins No. 236, "Farm Management," and No. 259, "What is Farm Management?" and Farmers' Bulletin No. 511, "Farm Bookkeeping," will be especially useful. Nor should foreign publications be neglected. A majority of these are in foreign languages and untranslated, but many are in English. Publications of departments of agriculture such as that of New South Wales should be watched by the teacher, and those of particular value sent for. In connection with this course, for example, New South Wales Farmers' Bulletin 43, "Bookkeeping for Farmers," will be found useful. Publications of organizations, such as the Michigan Political Science Association Papers on "Social Problems of the Farmer," are also often of value and may frequently be secured free of charge.

In assigning class reading references the valuable material in the general magazines should not be forgotten.

Excellent articles on farm management and rural social problems appear in them from time to time. In fact, the general periodicals probably contain more articles dealing with these than with any other agricultural topics. The school library will probably contain files of but few if any of these periodicals, but many of them may be found at almost any town library. By consulting the periodical indexes under such subject heads as farm products, farm management, farm life, and similar topics, many valuable articles may be traced. It must also be said, however, that there is much worthless material found in this mass of good things. The agricultural teacher should look over all such articles carefully before assigning them for class reading, to make sure that they are sound, from the point of view of good farm management, and not written merely to catch the reader's attention and arouse "back to the land" enthusiasm.

Among books, the farm management teacher will find many of interest for his school library in the following list: —

Bailey, L. H. Country Life Movement in the United States. N. Y. Macm. 1911.

Bailey, L. H. The State and the Farmer. N. Y. Macm. 1908.

Bexell, J. A. Farm Accounting and Business Methods. Springfield, Mass. Home Correspondence School. 1911.

BUELL, JENNIE. One Woman's Work for Farm Women. Bost. Whitcomb & Barrows. 1908.

BUTTERFIELD, K. L. Chapters in Rural Progress. Chic. University of Chicago Press. 1908.

CARD, F. W. Farm Management. N. Y. Doubleday, Page & Co. 1907.

CARVER, T. N. Principles of Rural Economics. Bost. Ginn & Co. 1911.

COULTER, J. C. Coöperation among Farmers. N. Y. Sturgis & Walton. 1911.

FAIRCHILD, G. F. Rural Wealth and Welfare. N. Y. Macm. 1900.

GREEN, J. B. Law for the American Farmer. N. Y. Macm. 1911.

HAYS, W. M. Farm Development. N. Y. Orange Judd. 1910.

HUNT, T. F. How to Choose a Farm. N. Y. Macm. 1906.

HUNT, T. F. The Young Farmer. N. Y. Orange Judd. 1912.

PLUNKETT, SIR HORACE. Rural Life Problems of the United States. N. Y. Macm. 1910.

POWELL, G. H. Coöperation in Agriculture. N. Y. Macm. 1913.

ROBERTS, I. P. The Farmer's Business Handbook. N. Y. Macm. 1903.

ROBERTS, I. P. The Farmstead. N. Y. Macm. 1907.

STERN, R. B. Neighborhood Entertainments. N. Y. Sturgis & Walton. 1910.

STREETER, J. W. Fat of the Land. N. Y. Macm. 1905.

TAYLOR, H. C. Agricultural Economics. N. Y. Macm. 1905.

United States Industrial Commission, Report. v. 6: Distribution and Marketing of Farm Products. v. 10: Agriculture, Land Tenure, Marketing, Agricultural Labor, Farmers' Organizations. Washington, D. C. Government Printing Office. 1901.

United States Country Life Commission, Report. N. Y. Sturgis & Walton. 1911.

WARREN, G. F. Farm Management. N. Y. Macm. 1913.

WARREN, G. F., and LIVERMORE, K. C. Laboratory Exercises in Farm Management. N. Y. Macm. 1911.

The community work which may be done along the lines of rural economics is especially attractive and greatly needed. Farmers have been told much, and have learned much, during the past few years, as to how to increase production. They need now to know more as to how to increase profits. They need a better understanding of the keeping of business records and accounts, and of their value, of how to prepare their products for market and how to sell them to the best advantage. They are becoming more and more interested in developing the social agencies of rural communities and in making the most of them. They want to know how to have a more interesting and helpful social life; how to develop rural sports and recreations; how to coöperate for mutual good; and how to improve their existing organizations.

It is the privilege of the agricultural teacher, familiar with what has been done along these lines in different parts of the country, to show them what they can do along these and other lines to raise the standard of country living and to emphasize its many advantages.

Before attempting any community work in farm management, however, the teacher should be sure he knows his field. He should himself do a little local survey work, in order to get acquainted with conditions,

the special economic and social problems of the farmers in the surrounding community. He should undertake to find out what is being taught in the surrounding rural schools; the amount of education the average farm boys and girls get and wherein it lacks in training for their particular work; what kinds of homes they live in; what particular advantages and disadvantages they have; what proportion of the farmers are tenants; what is the average size of farms; what kind of books farmers keep; whether farmers are fairly paid for their work or not; and many other things.

Some of this survey work may be done, if desired, as class practicums by students; but the teacher should himself get in touch with conditions. Only when he knows his field and its problems is he in a position to do effective community work dealing with problems of rural economics. When farmers feel that he *is* familiar with needs, he will be able to interest them in his suggestions, and they will feel that they are worth trial. Farmers' organizations may then be induced to make, perhaps under the direction of the teacher, a more thorough survey of the community conditions and needs than can be undertaken by him with his limited time and means.

These surveys may deal with social or other conditions. Data may be gathered for the purpose of securing information preliminary to the improvement of the social or the economic situation. But whatever the nature

of the surveys may be, they should be carefully planned and accurately carried out, pointing out clearly all the needed facts concerning the conditions being investigated, and thus forming a basis for intelligent effort on the part of organizations and individuals for the common good. In connection with the survey work, L. H. Bailey's Cornell bulletin, "The Survey Idea in Rural Life," and University of Wisconsin Circular of Information 29, "A Method of Making a Social Survey of a Rural Community," will both be found useful.

As another part of the community work of the high school, related to farm management, "country life conferences" may be arranged for, to be held at the school building or elsewhere. Here programs may be given at which such topics as the country church, the country school, banking systems and the farmer, coöperation in marketing, and many others are discussed. Short courses may be given in the keeping of farm records and accounts; in the advertising and marketing of farm products; in laws as related to the farmer; or in general farm management. On the school farm, experiments and demonstrations in crop rotation, in the use of fertilizers, and in the culture of new plants, may be made for the benefit of the community.

The difficulty is not to find useful work to do, but to know what can be omitted with least loss to the community.

OUTLINES OF HIGH SCHOOL WORK IN FARM MECHANICS AND FARM MANAGEMENT

A

Outline of farm mechanics work at the Gardena (Cal.) Agricultural High School. (Outline furnished by Mr. Robert J. Teal, instructor in charge of the work.)

In this school, grades 7 to 12 are included, the work in farm mechanics starting with the eighth grade.

Eighth grade

SHOP WORK	MECHANICAL DRAWING
Four hours per week throughout the year. First half year, elementary cabinet making. Second half year, making farm devices, poultry appliances, etc.	$2\frac{1}{2}$ hours per week in mechanical and freehand drawing, to be correlated with the eighth grade woodworking course, and in preparation for ninth year work.

Ninth grade

SHOP WORK	MECHANICAL DRAWING
Six hours per week throughout year. Course in farm carpentry and cement work. Instruction and practice in the construction of farm buildings. Actual construction has formed and will continue to form the larger part of the work in this course.	Four hours per week throughout year. This course is designed not so much to develop a mastery of technique as to acquaint the pupils with the methods of construction of various types of farm buildings. Includes making estimates, taking of bills of materials, etc.

Tenth grade

SHOP WORK	MECHANICAL DRAWING
Six hours per week throughout year. Farm blacksmithing.	Six hours per week throughout year. Elementary machine drawing.

Twelfth grade

SHOP WORK

Physics throughout the year will have an agricultural bearing. During the last ten weeks of the physics course the time will be given up to a practical consideration of farm machinery and farm motors. This is in addition to the theoretical consideration which will be given these matters during the remainder of the course in physics.

Mr. Teal says with regard to the farm mechanics equipment: —

"A new farm mechanics building is nearing completion, and will be ready for occupancy by the end of this month (April, 1912). It will contain a woodshop, mechanical drawing room, finishing room, lumber room, tool room, besides office, lavatories, and locker rooms. It is of brick, and will cost about $8000. It will be equipped with 24 woodworking benches and 24 mechanical drawing tables, benches and tables costing about $900; a circular saw; a band-saw; a jointer; a turning lathe; a power grindstone; and later with several more lathes and a planer. The present machine equipment cost about $1400.

"The forge shop was built by the students in carpentry. The material in it cost about $400. The equipment consists of 12 Buffalo #666 forges; one hand drill press; one power grinder; besides a full complement of vises, forge tools, etc. The equipment is worth probably $900."

B

Farm Management Outline

(From Michigan Agricultural College, Department of Agricultural Education Bulletin No. 7, p. 11.)

- Farm management.
  - Arrangement of fields, pastures, rotation.
  - Cost of crop production.
  - Most profitable crops.
  - Most profitable stock.
  - Housing of machinery.
  - Study and plans of farm buildings.
  - Drainage, tile, ditches.
  - Sanitation.
  - Accounts.
  - Crop values by current prices.
  - Comparison of crop yields.
  - Uses of soil.
- Farm mechanics.
  - Tools: kinds, care, purchase.
  - Machinery: setting up, care, repair.
  - Repairs: tools, harness, fences, buildings.
  - Construction.
    - Gates, fences, houses, etc.
    - Uses of cement.
      - Posts.
      - Tile.
      - Walks.
    - Bench work, forge.
  - Architecture.
    - Houses, barns, outbuildings, silos.

Note. — The excellent Maine and Minnesota outlines for courses in farm mechanics, farm buildings, and farm management in high schools are too long to be quoted here, but should be studied by every teacher planning such courses.

PRACTICUMS

1. Outline lecture, reading assignment, and practicum work for a high school course in farm buildings covering nine weeks, with four double laboratory and one double lecture and recitation period per week.

2. Prepare complete directions for ten practicums adapted to high school use, dealing with farm management problems.

3. Outline briefly a high school course in farm mechanics, to cover nine weeks. Make an itemized list of equipment needed for the course, with cost.

REFERENCES FOR COLLATERAL READING

Country Life. Symposium. Annals of the American Academy of Political and Social Science. March, 1912. v. 40.

Course in Agriculture for the High Schools of Michigan. Michigan Agricultural College, Department of Agricultural Education, Bul. 7. 1911. pp. 24–29.

Farm Management: Organization of Research and Teaching. U. S. Bur. of Plant Industry Bul. 236. 1912.

Report of the Committee (of the Association of American Agricultural Colleges and Experiment Stations) on Instruction in Agriculture. 1911. Office of Experiment Stations Cir. 115. 1912.

What is Farm Management? U. S. Bur. of Plant Industry Bul. 259. 1912.

CHAPTER XII

THE SCHOOL FARM

IT is conceded by all that the high school teaching agriculture should have some land at its disposal for practical outdoor work and experimental and demonstrational purposes. Further than that, there is little agreement as to anything that concerns the school farm. Opinion as to some points is very vague; as to others it is expressed very definitely but very diversely.

In general, we may safely say that the purpose of the school farm is to provide for pupils a place where application of agricultural facts and principles learned in the classroom from the lecture and textbook can be made; a place where the working of agricultural principles can be illustrated; a place where agricultural experiments in the growing of plants, the management of soils, the feeding of animals, and other farm operations can be carried on. Incidentally, the school farm furnishes convenient material for general science, biology, and other courses.

The work on the school farm should not only fix facts and principles in the pupil's mind by giving him practice in doing, but through repetition in the doing should give him good habits of work. The pupil should gain from

his field practicums a certain facility in caring for plants, animals, and equipment, and habits of doing such work properly.

Only through a proper emphasis of practical exercises, accompanying classroom instruction, can agricultural teaching in the high school accomplish its full purpose for pupils. The mistake is too frequently made of placing unwarranted reliance on the ability of students, after sound instruction in theory, to put that theory into successful practice on the farm. In only too many county, district, and special agricultural high schools having well-equipped farms of ample size, students do but very little actual farm work. They are given opportunities to observe experiments and demonstrations, but have little practice in farm operations themselves.

This is regrettable, for to see a thing done, however excellent the demonstration, has not the educative value of doing it one's self. Neither skill nor business ability can be gained from books and observation alone. We must have in the school work much of books and observation; but we must also have, if we are to send out capable workers, a sufficient amount of actual, practical farm work.

The agricultural graduate of the high school should have gained practical knowledge of farm methods and be able to go into farming as a business if his course has

done for him what it ought. He will have a more thorough understanding of his work if he goes on to the agricultural college, to be sure. But he should be able successfully to engage in ordinary farming if he has intelligently completed four years of well-planned agricultural work in the high school.

It may perhaps be well to note here the fact that the agricultural colleges are being criticized at present for their failure, in so many cases, to produce practical farmers, — except where their students have had previous farm experience. It is possible that this may be one reason for the insistency of the demand for agriculture in the high school. Undoubtedly this defect in the work of the colleges is due to the fact that little or no practical work is included in the college course. Though this may be excused in the colleges, where the avowed purpose is to produce "specialists," — agricultural experts, — it cannot be excused in the high school. And even in the colleges there is an increasing tendency to require a certain amount of practical farm work from students, just as engineering students are required to give certain vacations to practical work.[1]

If the high school "farm" is not of sufficient size to permit the amount of practical work desirable for each student, home or special project work — that is, the

[1] "Practical Farm Experience for Agricultural College Students." Experiment Station Record, February, 1913, pp. 101–107. Editorial.

utilization of home land, equipment, and time, outside school hours, for practical training supervised by the school — must be made to take the place of the work at the school. In fact, not a few agricultural teachers believe that by far the greater part of the practice work of students should consist of just this home project work, carried on under the supervision of the agricultural teacher.

There is little doubt but that, at the ordinary high school where students return to their homes at night, some home project work should be carried on in connection with at least a part of the agricultural courses. Even where students do not live upon farms it is probable that suitable arrangements for individual project work could readily be made. These may be carried out on farms of the neighborhood, or even in back yards, or on vacant lots, in case students live in town. Excellent poultry and garden projects, projects dealing, for instance, with the care and feeding of a single horse or cow, can be arranged for even in town. If desired, the older town students may be encouraged to work on near-by farms during the summer, for hire, special project work being arranged for in connection with this. Or, for a limited number of town students, special project work may be arranged on the school farm, though here a special effort must be made to throw the student on his own responsibility.

The projects undertaken by individual pupils may differ widely, or they may, in connection with certain courses, be the same. For example, in a rural school where the main crop of the community is corn, — all the pupils in the agronomy course one year grew an acre of corn as a home project. In connection with an animal husbandry course, or in a different school as a part of the work of the agronomy course, each pupil might have an entirely different project. Where the projects are the same, the element of competition introduced may have a good effect on the work. But in many cases it would be unadvisable or impossible to arrange the same projects for many of the pupils.

There need be no difficulty in the majority of cases in finding suitable home problems; for farming activities resolve themselves very readily into "projects." The greater number of these are of a productive nature, as the growing of a crop of clover or alfalfa, or the production of eggs for the market. But a project may be experimental, as in the feeding of an untried ration or the testing of an untried spraying mixture; or it may consist in making some improvement about the farm, as constructing a concrete walk or making a lawn. Whatever the home projects selected, they should be appropriate to the school instruction in connection with which they are assigned and to the home farm or village lot where carried on. If possible, they should be such as

appeal especially to the interest of the particular students undertaking them. That they should also command the interest and support of parents is perhaps needless to say.

Home or special project work has the particular advantage of not only giving the student practice in agricultural operations, — opportunities to apply the knowledge gained in the schoolroom, — but of affording also a means of developing his managerial ability. The securing of products of one kind or another is here emphasized above the mere correctness in doing different kinds of agricultural work which perhaps receives most attention in the practice work on the school farm. Furthermore, the amount of land and equipment necessary at the school is lessened, the cost of equipping the school for agricultural work is decreased, the student is given an opportunity to do actual productive work (the proceeds of which go to him or to his parents), and an ideal opportunity is afforded for the dissemination of scientific agricultural knowledge among farmers of the community and for the trying out of methods which have proved to be profitable elsewhere, — as, for example, at the state experiment station.

Once selected, a project should be continued to its logical close, which is normally the production of something of market value. Records of work should be kept by the student and neatly written up for the agricultural

teacher supervising his work at the completion of his project.[1]

The supervision of home project work by the agricultural instructor cannot be daily, obviously, nor can it deal with minute details, because of the number of farms or town back yards involved. Moreover, too close supervision as to details might cause friction with parents, and any appearance of interference with the management of farm work by the parents must be scrupulously avoided. But the projects to be carried on should be chosen largely by the agricultural teacher, with the approval of parents, and the student should be advised and assisted and encouraged in his attempts to carry out his project successfully and in accordance with proper methods.

It is evident, however, that if such work is adequately supervised it must mean considerably more work for the teacher than where the practical work of the student is carried on largely or entirely on the school farm area. Therefore where home project work is undertaken, agricultural teachers should be relieved of enough classroom work to give proper supervision without adding unduly to their working hours.

On account of the necessary variation in the time

[1] In planning project work for students, the Massachusetts Board of Education Bul. 1912, No. 5, "Project Study Outlines for Vegetable Growing," will be found suggestive.

and labor required to carry out different home projects, it is difficult to give suitable school credit for them. To measure accurately in credits either the information or vocational value gained from a given home project is almost impossible. However, each project should receive recognition as a part of the school work, and credit should be based on the way in which the work is done, as observed by the teacher and parent, upon the nature of the work and the time taken for it, and upon the final written report of work which should be handed in by the pupil. In addition, the products resulting from the project work, or a fair proportion of them, should, wherever possible, themselves become a reward for the work.

Whatever the project undertaken, a carefully written final report should be required. In this should be given a complete discussion of the problem or experiment undertaken, the scientific facts and principles involved, and the practical results accomplished. When the results are such that a general knowledge of them is likely to prove of value to farmers of the locality, and the report is well written, it may be printed in a local paper; or it may be issued by the school as an agricultural bulletin, if funds for the purpose are available.

It seems advisable, wherever possible, to have the home project work accompany and be a part of the several agricultural courses, — the training of the school thus

being related intimately and at once to practical affairs off the school premises. Yet this arrangement is not universally approved or followed.

In New York State, for example, it is planned that the home project work form a separate course, equivalent, if continued for a full year, to a "five count" or daily study course for that time. If covering a half year, two and one-half credits are given. In either case the summer vacation may be a part of the time during which the work is carried on.

Perhaps the ideal arrangement is attained where agricultural students of the high school live on farms and carry on home project work in connection with each of their school courses. While the freshman is studying the elements of soils and plant life, he has plots of ground on the school farm where he applies his knowledge under the direction of his instructor, — getting practice in certain operations or kinds of work. At the same time, he has a plot of ground at home, preferably parts of the kitchen and flower garden, where he applies all that he has learned in his class and garden at school, or from agricultural publications, in the production of a crop. There his methods are compared with his father's and those of neighbors. He may thus learn certain things from them; and they may learn from him. In the sophomore year he will have certain practicums at the school in connection with his animal husbandry work. At the

same time he may have, at home, training in caring for some of the animals on the farm, as poultry, bees, a horse, or a cow. In his junior year, in addition to his school practicums, he may carry on a home project dealing with fruit or vegetable growing or marketing. And in his senior year he may, in connection with his school study and practice in farm mechanics and farm management, carry on, as a home project, the keeping of certain records and accounts, the repair of farm machinery, or other problems.

Thus every farm from which a student comes is made a part of the working outfit of the school. School and farm — theory and practice — are intimately related. Each contributes to the other.[1]

Unfortunately, these ideal arrangements are frequently non-existent, and it is then necessary to make the best of less favorable conditions. Rural high schools, a majority of whose agricultural students come daily from farms, are especially fortunate in their work because of the possibility of thus combining school study and field exercises with practical work on the home farm. In high schools where many of the agricultural students come from town homes, special arrangements must be made to meet the practical needs of the work.

The home project work is perhaps carried further in

[1] Smith's Agricultural School, Northampton, Mass., is a good example of schools emphasizing work of this character.

the plans of the Massachusetts Agricultural Education Service for agricultural departments in high schools than in any other state plans so far outlined. As Mr. R. W. Stimson, Agent of the Service, says in a 1911 bulletin: "From the definition of agricultural education found in the new (Massachusetts) law, it will be evident that the determining factor in choosing both the subject matter and the methods of instruction for the agricultural departments must be productive farming. Work, therefore, scientific and economic, on farms, preferably on the home farms of the boys themselves, must be provided for throughout the periods of training. The productive work required of the students will be organized into a graded series of individual farming projects. Among these each student, with the consent of his parents, will choose an approved list from year to year. His agricultural education will then consist of learning to glean from all possible sources the scientific knowledge required for the thorough understanding and the profitable execution of his farming undertakings, when subject, as they must be, to all the natural helps and hindrances of actual local conditions."

Since summer supervision of home projects is necessary where they continue into or through the summer vacation, and since in cold climates this must usually be the case, it is planned for the Massachusetts schools that the agricultural instructor take his vacation in winter, super-

vising home project work during the fall and spring terms and summer months. This in turn necessitates confining agricultural instruction to the fall and spring terms of a three term school year unless more than one agricultural instructor is hired by each school. Whether these plans for work will prove as satisfactory in practice as they are when described, remains to be seen. In states where the school year is divided into two terms, it is obvious that the long winter vacation for the agricultural instructor would not be practicable.

In addition to its use for pupils, the school farm should serve to some extent as a demonstration farm for the community. Here demonstrations of methods or practices which would be of benefit to farmers if more widely introduced are carried on, as, for example, with fertilizers and rotations, cover crops, in the breeding and selection of corn and other cereals. Space is given to the growing of desirable new plant introductions, — new fruits, vegetables, and field crops which it is thought probable may prove worthy of being grown for commercial purposes in the locality. Trial is made of new varieties of crops already grown in the locality, and the results compared with those attained in the growth of the common varieties, to determine which variety it is most profitable to grow.

In the opinion of some agricultural teachers every high school farm should also be, in a sense, an experiment

station, which may or may not be worked under the direction of the state experiment station. By some it is thought that the agricultural teacher should, in addition to carrying on regular demonstration and experimental work on the school farm, take up any agricultural problem with farmers of the community at any time desired, going to their farms and helping in finding a solution, or carrying on experiments at the school farm for the same purpose. There is no doubt that there are many reasons for carrying on both these lines of work. If the director of the agricultural work in a high school has sufficient assistance, in class and on the school farm, they may well be taken up. But an agricultural teacher should not be overburdened with work any more than should any other teacher. In connection with special county and district agricultural high schools, there is no doubt that considerable experimental work and work for individual farmers should be carried on. For the ordinary town high school but little such work will be possible, in addition to the practical work for students and the demonstrations for the benefit of students and farmers, unless a definite amount of time is set aside for the purpose.

In discussing the purposes of the school farm it has been said many times that it should "serve as a model for the community." It is true that it should be a model in so far as the proper care of plants, animals, and equipment

is concerned; but there it may cease to be one. For the purpose of the school farm is educational rather than commercial. Its reason for existence is that it may serve educational ends, for pupils and for the community. It is desirable that the farm "pay," but it is not a matter for criticism if it does not. The primary purposes of plant culture and animal raising on the school farm are educational. Crops are not grown to "pay." They may yield a profit, it is true, but that is a secondary consideration. The special nature and limited extent of the experimental and demonstration plots possible on the average school farm for educational purposes are not such as to make a profit on products at all probable; and the number of workers to be accommodated on the farm and to be given work which is distinctly educational is unfavorable to the securing of financial gains.

However, in the case of schools where sufficient land is owned, the farm is sometimes divided into what may be called a commercial farm and a demonstration or educational farm. That is, a part of the school farm is run as a commercial farm, as a model or to meet financial needs of the school, or for both reasons. In this case it should be the aim, so far as is feasible, to make the management, appearance, yields and profits of this part of the school farm a model for the farmers of the community. The care of crops, animals, and equipment should approach the ideal as nearly as possible. Records

and accounts should be carefully kept and may be made known to the public regularly. Marketing of products should be given special attention, both as to preparation of products and their disposition.

It is the exception rather than the rule, however, for a high school, or other secondary school giving agricultural courses, to own a farm run on a commercial basis. The educational purposes of a school farm have been practically the only ones considered. The model commercial farm is, to be sure, distinctly educational; but it is too large an educational exhibit for the ordinary high school to undertake to provide. County or district agricultural high schools usually have more land than the ordinary high school teaching agriculture. They are expected to do more experimental and demonstration work. They may therefore well make the running of a model commercial farm a part of their work. But for the ordinary village or town high school this will always remain impossible.

The question of ownership or rental of the school farm possibly needs no discussion. It is, obviously, preferable for the school to own its "farm," that permanent improvements, such as buildings, may be added as needed, for the sake of long-time experiments, and for other reasons. Where this is for the time being impossible, rented land, located conveniently to the school building, may be utilized. Where land is rented it should, for

the sake of experiments, be for a term of years rather than for a single year; yet the very fact that land is rented for a considerable time may sometimes prevent a school board from purchasing a desirable tract when available.

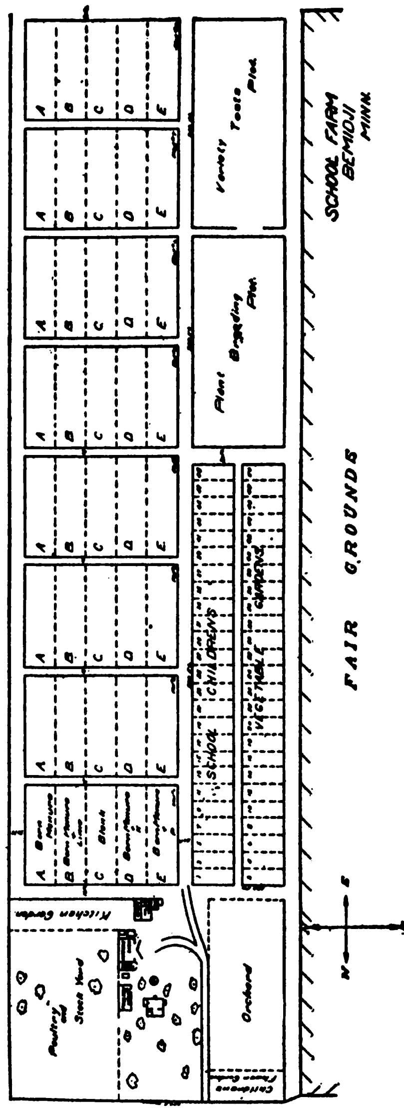
Perhaps no point concerning the school farm is more disputed than its proper size. One agricultural writer [1] states that the large rural school should have from one to three acres, and a consolidated rural school or agricultural high school five to ten acres. Another states that for a high school where boys go daily to their farm homes, where they are expected to carry their school lessons for application, ten acres should provide all of the necessary space for the agricultural purposes of the school, including "building site, playground, athletic fields, stables, agriculturist's cottage and private grounds, field demonstration plots, and, possibly, school gardens and students' projects." [2]

Where in one case a school farm of perhaps more than twenty acres may be very well utilized in connection with the agricultural work of a high school, possibly four acres prove more than are used to advantage in another.

And though, as we have said, the general agreement is that the high school should own some land for practi-

[1] Row, R. K., "Educational Meaning of the Manual Arts," p. 226.

[2] Main, Josiah, "Educational Agriculture," p. 64.



PLAN OF TEN ACRE HIGH SCHOOL FARM, BEMIDJI (MINN.)

cums and demonstration purposes, yet the New York State Education Department bulletins on agriculture in the high school so far quite ignore the subject of land equipment in discussing the work. In fact, it seems to be implied that the ordinary high school will have little if any land for such purposes. It is true that the value of home project work is urged and that a suitable amount of this may be made to take the place of practical work on a school farm. Yet it is doubtful if a certain amount of work on a school farm can be entirely dispensed with.

In the Michigan Agricultural College and State publications on high school agriculture the need of a school farm is also given little attention, though it is stated in Michigan Agricultural College Department of Agricultural Education Bulletin No. 7 that each high school teaching agriculture should have one-half to one acre of land for an experimental plot and for instruction in seeding and plant culture. However, in Michigan, too, home work and working trips to vineyards, fields, and barns of the community are given especial attention.

Yet that some sort of school farm is imperative as a part of the equipment of the high school that teaches agriculture, may probably be safely asserted, notwithstanding the lack of emphasis placed on the ownership and use of land by high schools teaching agriculture in

these two states. The farm need not be large and costly for the ordinary high school, but it should not be entirely omitted in equipping the school for agricultural work.

In determining the size desirable for the school farm in any given case, various factors must be considered. Among these are the nature of the agricultural courses given in the high school, the number of agricultural students, the price of land per acre, and the equipment and labor available for the care and management of the land. In the case of county and district or other special agricultural high schools it will also be necessary, in determining the amount of land which will be needed, to decide as to whether the farm is intended merely to serve the educational needs of the school or whether a part of it is to be used as a sub-experiment station for the good of the community and as an aid in the work of the state experiment station; whether it is to be used for these purposes alone, or a part is to be worked for commercial purposes, to serve as a model farm or to help pay the expenses of maintaining the school. In the ordinary town or village high school, where the farm is for instructional and demonstration purposes alone, these last points need not be considered.

The size desirable for the farm depends upon the size of the high school — the number of pupils — to a less extent than might be expected. This should be con-

sidered, it is true, but is a matter of minor importance. In fact, in many cases it may be desirable for the small school, on account of its location, community interests, etc., to have a larger farm than the large school. What is too small a farm for one school or locality may be too large for another, perhaps differing from it but little in the number of students. A plot of land which serves very well the agricultural needs of a large town or city high school may be quite inadequate for the agricultural work of a rural high school.

In a way, the question is one of utilization. A school should have in its school farm as much land as that particular school, with its definite aims and needs, can utilize profitably and fully. It should not have more.

The farm should not be too large to be kept in perfect condition by the labor of students and the instructor and that which can be hired. And it should not be so small that it does not furnish a suitable amount and variety of agricultural practicum work for the agricultural courses taught in the high school. However, this "suitable amount" depends to no small degree on how much home or special project work is arranged for, away from the school grounds.

The equipment for a school farm may be divided into three classes, — buildings, implements and machines, and live stock. The nature and extent of the equipment in

each case depends upon many factors, such as the size of the school farm, agricultural courses given in the school, experimental work planned, and provisions as to the management of the farm and the labor to be done on it. It is, obviously, impossible to discuss it with any definiteness except in relation to particular schools and circumstances.

Yet there are certain things that should be included in the farm equipment of every high school teaching four years of agriculture. There should be a greenhouse or lath-house for plant propagation work; a farm shop, for practical work in farm mechanics; a place to house tools and machines; and a storeroom for seeds, fertilizers, and other materials. The shop and tool and machine room may be in one building, separate from the main building, — though possibly forming a part of a manual training building. The storeroom may also perhaps best be in this building, though it is not objectionable to have it in a basement room of the main school building, provided it has an outdoor entrance and is conveniently situated and arranged. If necessary, provision may be made in the main building for the shop and machine rooms, though this is seldom if ever advisable if it can be avoided.

Where pumping is necessary for irrigation purposes, a pump and engine house must be provided. In any case, there must be suitable provision for a water supply

for the school farm, either from wells, irrigation ditches, or a town water supply system.

Where live stock is kept, provision must be made for its housing. On a small school farm, of an acre or two, it is evident that but little live stock can be kept. However, even on a small tract, poultry and bees may be kept if they are of sufficient importance in the community to be taught in the school. For the work of a small farm a man and horse may be hired by the day when needed. As the amount of land is increased, it becomes advisable for the school to own horses to work the place. Where a considerable proportion of the feed necessary for stock can be raised on the farm, cows should be added.

It is of course impossible for the ordinary high school to equip its farm with enough live stock for illustrative purposes in connection with the animal husbandry and dairy courses. The farms of the community must be turned to for many illustrations and lessons. But it will be found of advantage to have some of the larger farm stock on the farm if they can be economically accommodated and fed, even though the number be very limited.

In a few sections it has been recommended that milk goats take the place of cows on the small school farm. But this would probably not prove advisable in the majority of cases.

When horses and cows are owned by the school a barn becomes necessary; and where any live stock is kept on the farm, with the possible exception of poultry and bees, there should also be a house for the agricultural teacher or farm superintendent. Respect for public property is not, unfortunately, universal. It is therefore well for some one who takes a personal interest in the school farm property to live on the farm as soon as it goes beyond the school garden size and the equipment includes buildings, implements, and stock.

When the work of the farm is done by students with the assistance of occasional labor hired by the day, the agricultural teacher should live in the school farm house. When the farm becomes large enough so that it is necessary to hire a farm superintendent by the year, he should live on the school farm.

The machines and implements belonging to the school farm equipment should be carefully selected to meet the needs of the farm work and student field practicums. There should be no waste of money for unnecessary costly machines, yet the equipment should be as complete and up-to-date as possible. Extravagance should be avoided in purchasing this part of the farm equipment just as much as in purchasing laboratory apparatus; yet the school farm machines and tools are partly for illustrative and educational purposes as well as for the doing of certain kinds of work. Some implements which,

though useful, could be dispensed with under other conditions may, therefore, be bought for the school farm. Garden tools will be necessary for every school farm; the other tools and machines to be purchased will depend on the size of the farm, courses given in the school, and various local conditions.

The equipment in land, buildings, implements, and stock should be determined only after careful thought and consideration of the special local conditions and needs. It should be adequate, since good work cannot be done without proper equipment; but, though ample, it should not be extravagant. It is far better to begin with a small farm and equipment and to increase as need demands than to burden the agricultural work with any land which cannot be properly equipped and cared for, or with equipment that cannot be utilized at the start.

Having provided a school farm, adequately equipped, provision must be made for its care and management both during the school year and the summer vacation. One great defect in the agricultural work in the ordinary high schools so far has been the lack of care of the school agricultural grounds during a most important period, — the summer vacation. Agricultural teachers, like others, have been hired for the school year only, and at its close have left for vacation trips or to go to new fields of labor. The care of demonstration and other plots has been left to the irregular and voluntary care of stu-

dents or to occasional and usually uninterested hired labor. Demonstration plots then become a bad rather than a good lesson to the community, and projects started during one year fail to be carried over to the next. To prevent this undesirable condition, some one vitally interested, and paid for the work, should be in charge of the farm during the summer months.

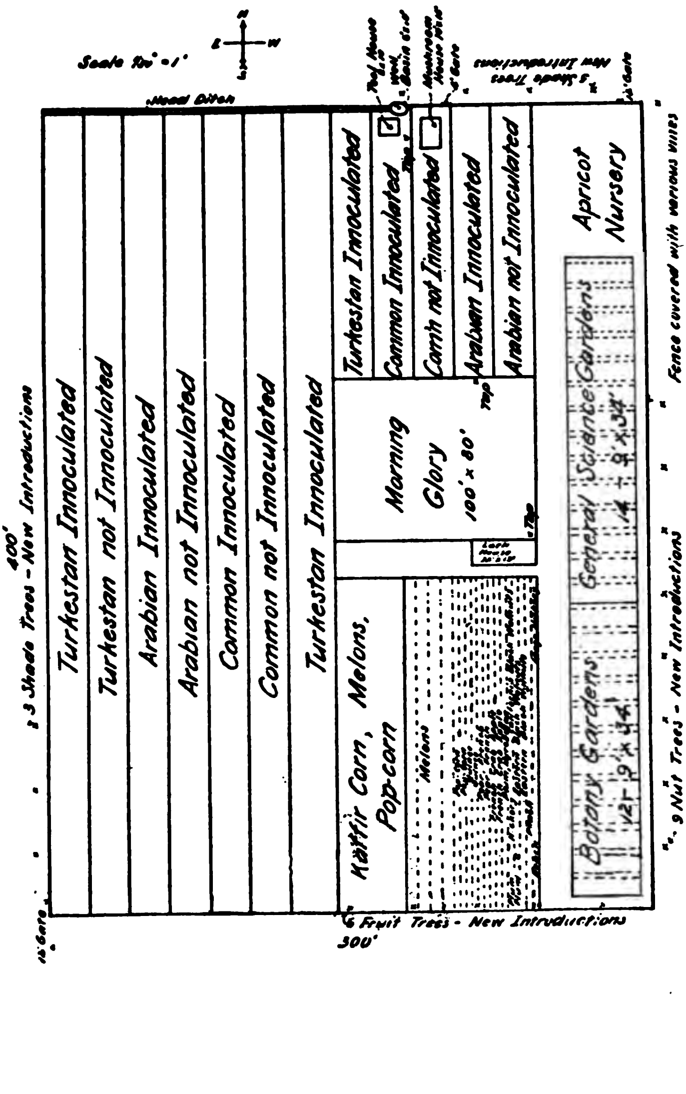
In the case of the small school farm the summer care and management will naturally fall upon the person in charge of the agricultural department of the school. He should therefore be hired by the year, and the care of the farm should devolve upon him during the summer vacation period. Since this brings to him, as it must, increased salary, and probably the use of a residence on the grounds, there should be little if any objection on the part of the teacher to the increase in service demanded. If a part of the grounds can be given to the agriculturist for personal use, or if he is allowed a part of the farm products, it will also add to the desirability of the work. However, the agricultural teacher in charge should not be unduly burdened with manual labor either during the summer or at any other time. A suitable amount of hired labor should be provided.

Where there is more than one agricultural teacher, the vacation service and care of the farm may be divided if desired.

In the case of the county, district, and special agricultural high schools, having farms of considerable extent, where a farm superintendent is hired by the year, the agricultural teachers may all, if desired, be allowed the regular summer vacation, the farm superintendent taking entire charge and care of the farm for that time, though of course carrying out the plans of the director of the agricultural work of the school. An ordinary high school farm will perhaps not usually be of sufficient size for a farm superintendent to be hired by the year.

Opinions differ as to the amount of work which may properly be required from students on the school farm. In the special, county, and district agricultural high schools a much greater amount of time may be devoted to such work than in the ordinary high school.

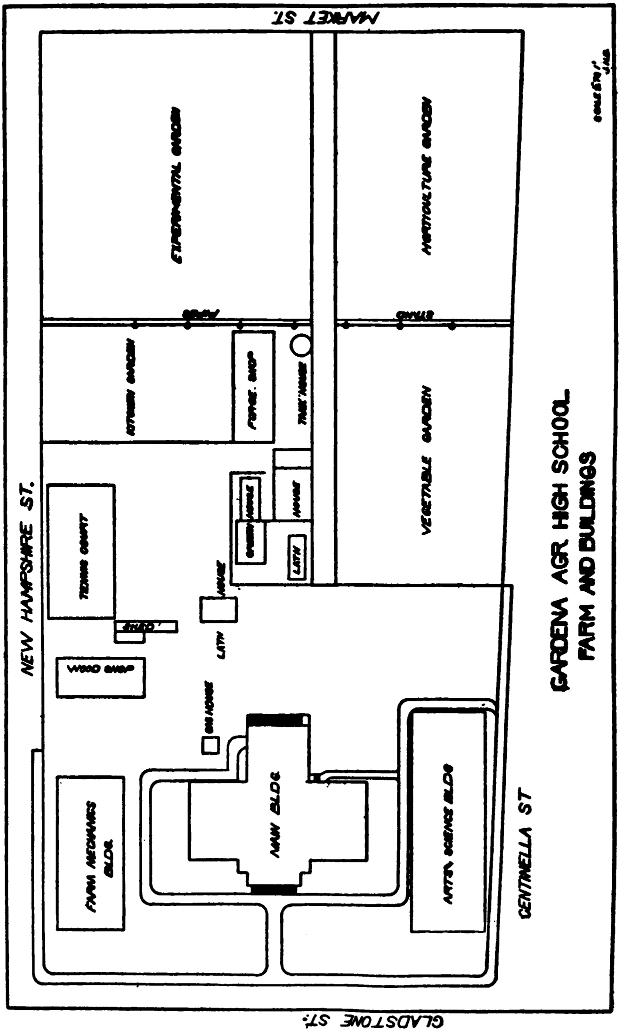
Where there is a model commercial school farm, the work on the farm may be done partly by students, as practice work, and partly by men regularly employed. In any case the work here should be under the immediate supervision of a superintendent, to whom the agricultural instructor or instructors make known what practice work they would like to have students do, and he arranges for it as suits the farm work best. Where student practice does not "fit in" with the plan of work for the commercial school farm, this should be arranged for on the "educational" part of the farm.



PLAN OF THE HIGH SCHOOL FARM, OXNARD (CAL.).

A plan somewhat like this is followed in the New York State School of Agriculture, at Canton, N. Y., where, as Dean Cook tells us in a letter, the "school farm is divided into a commercial farm and a demonstration farm, each separate from the other. The farms are under the immediate supervision of a superintendent. The work is done partly by students and partly by men regularly employed, student work predominating. Before the close of the school year, students work alternate days; that is, from the time the land is workable. After school closes, students are paid wages for their work. The students who remain with us during the summer are those who are especially adapted and whose scholarship is high. The relationship of the instructor is indirect through the superintendent to the workers. The superintendent is employed by the year, beginning September first. He lives on the school farm, and his home is furnished free."

In the ordinary high school it does not seem wise to require more time and labor from the student for farm work, aside from special projects for individual pupils, than is covered by the class practicum periods. Emphasis must, however, be placed on the fact that there must be special project work along all lines of instruction, on the school farm, at home, or elsewhere, or this arrangement will not give students sufficient practical work. Additional student labor may be hired, or else should

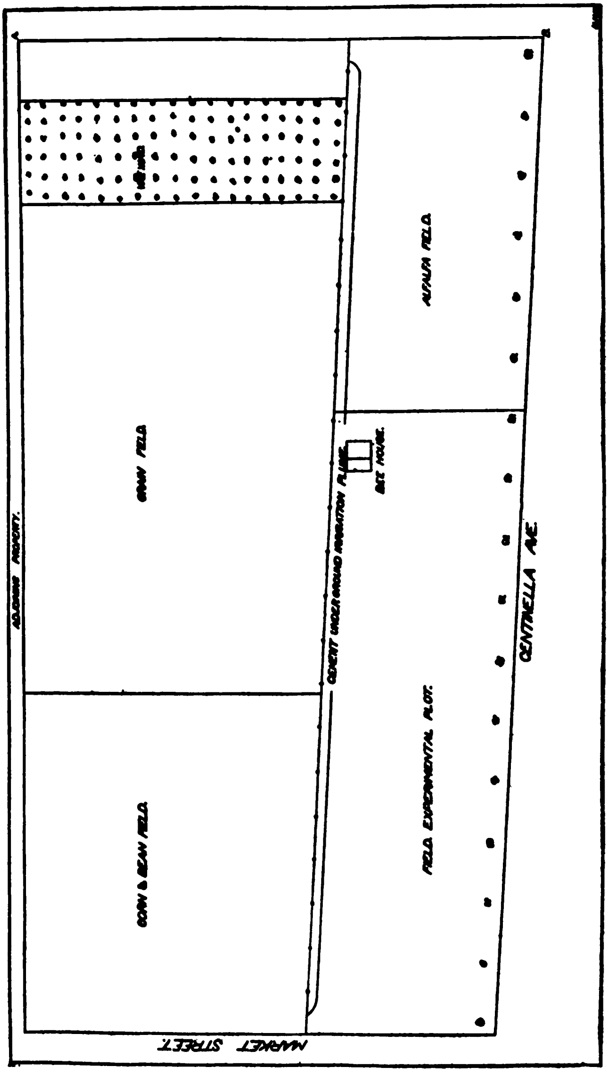


GARDENA (CAL.) HIGH SCHOOL FARM, SOUTH SECTION.

be given voluntarily by students. In some schools it is the practice to set aside a day or two during the school year for a general farm "house-cleaning," when all of the time of students is given to this special task. In most cases this is looked forward to with eagerness as an interesting variation in the program. When, as is frequently the case, the domestic science department or the girls of the school furnish a mid-day lunch as a part of the program of the day, it does not lessen the general enthusiasm.

The cost of a school farm includes the initial purchase price of land and equipment, and the cost of maintenance. In the case of a commercial farm the cost of running the farm is supposed to be but a fraction of the profits yielded by it. In case of the school farm the cost of maintenance is very likely to be considerably more than the amount of receipts from products.

Both initial cost and the cost of running the school farm differ widely even for farms of about the same size. Location, projects undertaken, availability of labor, efficiency in management, and many other factors have to be reckoned with. Beyond a certain point, neither the size nor cost of the farm and its maintenance seems to bear much relation to efficiency in the school work accomplished. The farm and its equipment must be adequate for certain purposes, determined partly by courses of instruction and partly by local conditions.

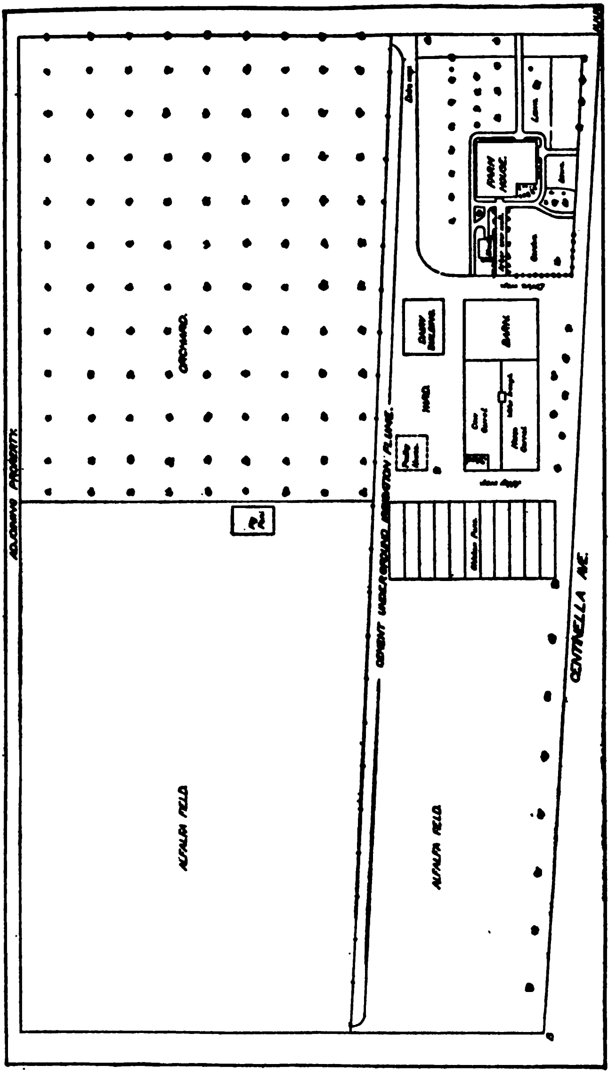


GARDENA (CAL.) HIGH SCHOOL FARM, MIDDLE SECTION.

Increases beyond that point seem to have little effect upon the value of the agricultural instruction of the school. Excellent work is done in schools having farms of considerable size; but equally good work is frequently done in schools having much smaller farms.

Comparatively few figures are obtainable as to the cost of agricultural grounds, their equipment and maintenance, for the ordinary high school. If a large number of accurate statements as to these points, for high schools in different parts of the country, could be collected, it would be of great advantage to those planning the introduction of agriculture in other schools. But the few statistics which we can secure at present, with their incomplete and approximate figures, are of comparatively little value.

Though there is a fairly general agreement as to the purposes which the school farm should serve, its utilization naturally varies greatly. In one, the demonstration plots for the benefit of farmers may be emphasized; in another they may be given little attention. In one case considerable individual plot work is carried on by students on the school farm; in another, such work is largely carried on at home. Experimental plots may be a feature on one farm, while on another they are conspicuous largely by their absence. The crops grown differ in different localities. The arrangement of the farm is influenced by many factors.

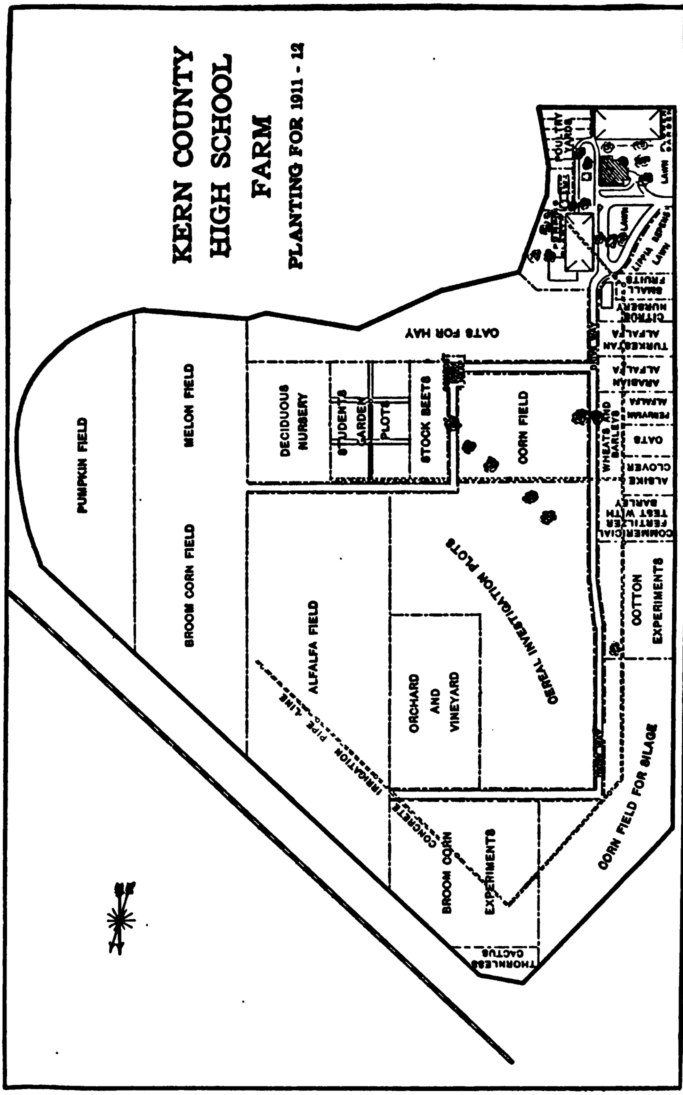


GARDENA (CAL.) HIGH SCHOOL FARM, NORTH SECTION.

However, in making plans it is helpful to note and compare high school farm plans which have been found satisfactory in different places. Three of these are described and illustrated here, — one a 2¾-acre farm, at Oxnard, California; a second a 14-acre high school farm, at Gardena, California; and the third a 27-acre farm, at Bakersfield, California.

The Oxnard school farm of 2¾ acres is located across the street from the high school, within the city limits of a town located in the center of one of the richest agricultural regions in California. It was purchased and equipped at a cost of a little less than $4000. Of this, $2474.45 was paid for the land. About $250 was spent on buildings, including a glass-house, lath-house, and a mushroom house. The cost of leveling and fencing the land and of a well for irrigation purposes amounted to nearly $900. The rest of the sum expended went for tools, seeds, plants, fertilizers, labor, etc.

The farm is managed by the one agricultural teacher of the school, and the work is done by students as practice work and by the two school janitors. The agricultural teacher is hired only for the school year, the janitors caring for the "farm" during the vacation. The crops grown and the location of buildings, with the exception of a greenhouse which is across the street on the school building grounds, are indicated on the farm plan here given.



Plan of the High School Farm, Bakersfield (Cal.).

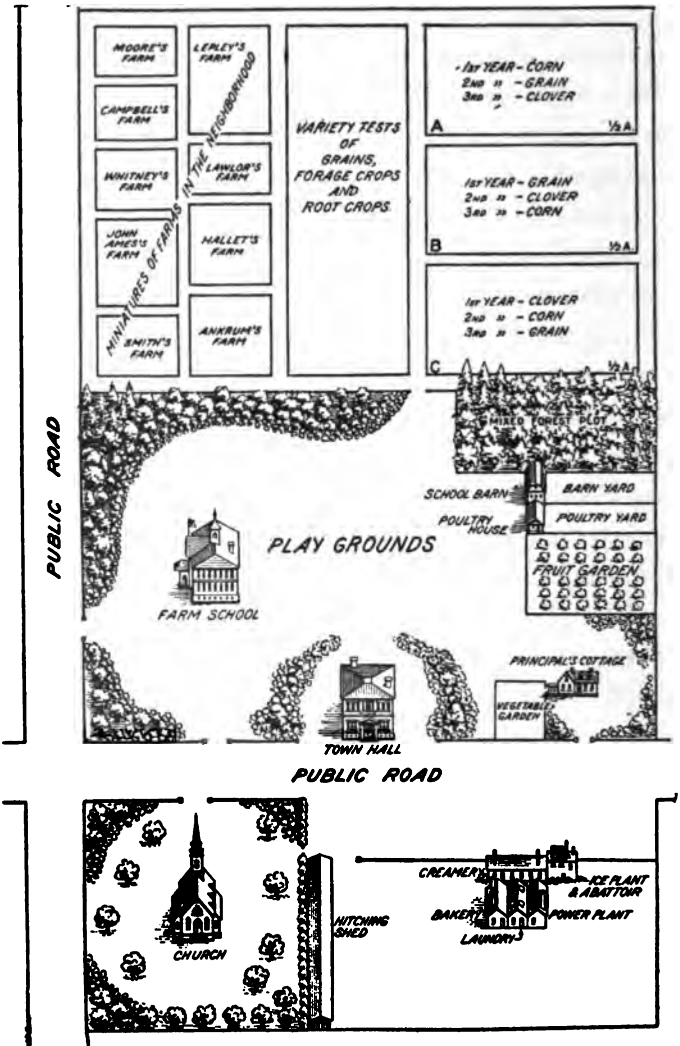
The Gardena, California, high school farm consists of 14 acres (which it is expected to double very soon). The soil is largely a clayey loam, rather shallow, and with hard pan beneath. An irrigation system is installed, and most of the land is ready for irrigation.

Mr. C. F. Palmer, director of the agricultural work up to July, 1912, states that the students do as much of the farm work as is possible in class practice work periods. In addition, a farmer is hired by the year and an assistant farmer for a part of the time. These do all the work of the farm during the summer.

The agricultural instructors (in horticulture and farm crops, animal husbandry, and farm mechanics) superintend their own phases of work on the school farm throughout the year.

The land value of the school's equipment is estimated at $25,000. The buildings include a house and barn, lath-house, pump house, glass-house, and blacksmith shop. The cost of maintaining the farm is estimated at about $1200 per year, and it is not expected that the farm should ever maintain itself.

At Bakersfield, California, the farm of 27 acres, located within easy access to the high school, was purchased at a cost of $16,000. The soil is a rich sediment, underlaid in places with sand. The installation of a pumping plant upon the farm cost $675, and a ten-inch irrigation system cost $700. Machinery and



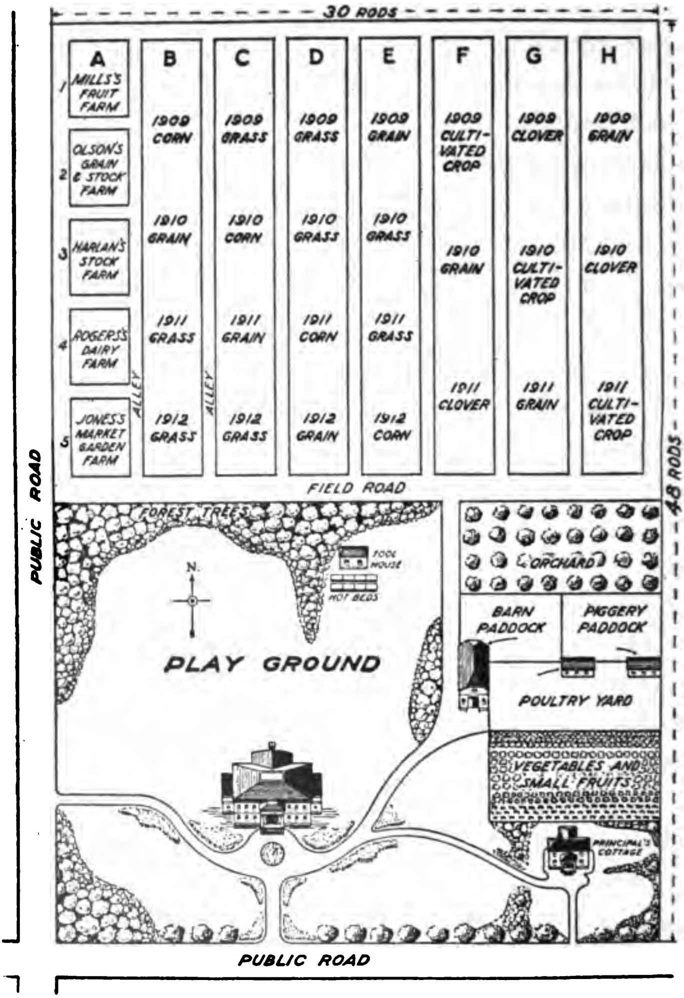
PLAN OF SCHOOL GROUNDS, SHOWING MINIATURES OF FARMS IN THE NEIGHBORHOOD.
(From Office of Experiment Stations Cir. 84.)

tools cost between $700 and $800. The buildings include a dwelling, machine shed, poultry houses, and an incubator and brooder house. The dwelling and machine shed were on the land when purchased. The other buildings are worth about $400. It is planned to expend about $1500 for stock, including poultry, registered mares, and other animals. The farm is also to be equipped with a small herd of the best dairy cows, a well-furnished dairy, and other buildings.

The agricultural instructor lives in the farm dwelling and supervises the farm work throughout the year, keeping records of all expenditures and receipts, plantings, breeding, etc. Two men are hired regularly for the work of the farm. Mr. H. F. Tout, the director of the agricultural work of the school, estimates that students do about one-tenth of the farm work.

The annual cost of maintaining the farm is estimated at from $1500 to $2000. The annual receipts, so the agriculturist states, "are not a consideration as yet."

In considering the planning of the school agricultural grounds, the idea of utilizing a part of them for the representation of farms in miniature, as set forth in the suggested plans for a 10-acre farm for a rural consolidated school in Office of Experiment Stations Circular 84, is interesting. Two such plans are here illustrated. Whether it would be advisable for the ordinary high



MINIATURE FARMS ON THE SCHOOL GROUNDS.

(From Office of Experiment Stations Cir. 84.)

school to utilize any of its land for miniature farms seems open to question.

Whatever the crops grown and the arrangement of the school farm, the use of land by the ordinary high school should be distinctly educational and adapted to the instructional work of the school. The majority of schools have, up to the present time, made too little profitable use of land from a pedagogical standpoint. Special, county, and district agricultural high schools seem to need particular warning against the use of land for show purposes only. There have been, in connection with such schools, too many farms whose major purpose was to please the eyes of the people who might see them and to make the farm a means of drawing appropriations from the several political bodies managing the financial affairs of the institution. The use of school land for purposes which cannot be defended from the standpoint of useful teaching and practical educational demonstration is detrimental to the agricultural work of a school, and should not be permitted.

PRACTICUM

Plan and map to a scale a school farm for use in connection with the work of a high school giving a four-year agricultural course. Describe the equipment needed in buildings, stock, tools, and machines. Discuss crops to be grown and provision to be made for the care and management of the farm.

Give reasons for your decision as to the proper size of the farm, the equipment needed, crops to be grown, and care and management.

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CHAPTER XIII

THE HIGH SCHOOL AGRICULTURAL TEACHER

THE introduction of agricultural instruction in the public schools is now encouraged in practically every state of the Union. In many states it is required by law in the elementary schools. In a number of states legislation has been enacted whereby substantial aid is given to high schools introducing agriculture. The economic need and educational value of instruction in agriculture is recognized. Throughout the country there is an increasing demand for teachers of agriculture.

All this is well and good; but if agricultural instruction is to be effective, — if it is to live up to the promises that have been made for it, — we must have efficient agricultural teachers. If untrained teachers, poorly informed as to agricultural principles and practice, are allowed to teach in our schools, they will, inevitably, do harm to the cause of agricultural education. The value of agricultural instruction will be greatly lessened, and even those students to whom good agricultural training would be most useful will be prejudiced against it.

In the high school it is especially necessary that the agricultural teacher not only have agricultural knowl-

edge, but the ability to impart that knowledge. In the college, persistent students may gain information in spite of the poor methods of presentation that are all too common. In both the high school and the elementary school it is of the greatest importance that the teacher should not only know the facts of agriculture, but the best means and methods of presenting them.

The normal schools are now endeavoring to prepare teachers to give agricultural instruction in the elementary schools. How well or how ill this is done as yet it is not our province to discuss. Graduates of the normal schools have not, ordinarily, sufficient education or training to teach in the high schools. For teachers for the secondary schools we must look to the colleges.

Unfortunately, the number of agricultural graduates of colleges is as yet small as compared with the graduates in other lines, as, for example, English, or history, or languages. The majority of these agricultural graduates either become instructors in colleges or go out to try their hands at some line of practical, scientific farming. The high school administrator has, therefore, few to select from. Of these few, perhaps all have sufficient technical knowledge, but only a small remnant are properly qualified for the special work of teaching.

As a result, in response to the demand for agricultural instruction and in recognition of its value, science teachers

with no technical agricultural training, or agricultural college graduates with no knowledge of teaching methods, are too frequently found giving agricultural instruction in the high school. Or, still worse, we sometimes find a teacher whose chief qualification seems to be that "he was brought up on a farm."

The work given by teachers of either of these three classes is almost always disappointing.

The agricultural graduate who knows only technical agriculture is apt to select and to present his materials for instruction in an unpedagogic, unsystematic way, — often "above the heads" of his students. He overemphasizes the particular phases of agriculture in which he is most interested. If the school work is too specialized and technical, students are discouraged at the start. If the agricultural teacher lacks general culture, the educated people of the community are apt to lose respect for both him and his work.

The pure science man fails in his agricultural teaching because he lacks a proper viewpoint in his work; he is apt to be out of touch with the various agencies of agricultural education; and he is almost always lacking in practical farm knowledge and experience.

The man whose sole qualification is that he was brought up on a farm may know ordinary farm practice, but he does not know its why and wherefores. He falls into errors in practice because he does not understand

the scientific basis of agriculture; he does not know the principles of agriculture.

With such teachers as these, agricultural instruction fails in its aim. Both subject and teacher gain but ill repute with pupils, with the high school teaching force, and in the community at large. Instruction reacts disastrously on the very movement it is intended to promote, and the cause of agricultural education suffers through those whose greatest interest should be in promoting it.[1]

If we are to have efficient, competent teachers of agriculture in the high school, they must be properly

[1] "One of the cardinal difficulties in the organization of agricultural education is the lack of trained teachers. Teachers who have grown up in the normal schools or those who go into the profession from colleges and high schools without a normal training, very seldom have practical experience adequate to give them a comprehension of farm problems. On the other hand, those who have practical experience find it difficult to secure the scientific training which is necessary to make instruction in farming sufficiently advanced to justify calling it a science. The graduates of agricultural colleges are either so much in demand for practical positions, or so poorly qualified for the special work of teaching, that they do not enter upon the teaching profession after they complete their agricultural course. The result of this whole situation is that there are many efforts being made to teach agriculture from textbooks, and these efforts are being criticized by practical people and educators alike as too abstract. In other quarters instruction lacks that systematic and progressive character which can come only from the study of the sciences upon which farming must ultimately rest. Practical farmers are no better teachers than the abstract students of textbooks." — C. M. Judd, Introduction to B. M. Davis, "Agricultural Education," p. 3.

prepared for their work. They must be thorough scientists, technically educated agriculturists, practical farmers, and trained teachers.

The preparation of an agricultural teacher should include, first of all, a thorough grounding in the elementary principles of science, a detailed technical study of agriculture, and a certain amount of training in farm practice. It should include study of rural sociology and agricultural economics. And it should include enough other work to give insight into different fields of knowledge and avoid over-specialization.

Along professional lines it should include some study of the history of education, especially agricultural education, and of the place and purpose of agriculture in the high school; a general study of the principles of education; of educational psychology; and of school management. Lastly, it should include special study of methods of teaching agriculture in secondary schools, and observation and practice teaching of agriculture with secondary pupils.

That the teacher of agriculture in the high school needs a detailed and specialized knowledge of his subject is unquestioned. The preparation necessary for the high school teacher of other subjects, such as history, Latin, and mathematics, includes, by common consent, university or collegiate training in his specialty. This necessity is no less for the teacher of agriculture. In fact, univer-

sity training is probably more essential for him. For it is usually expected of an agricultural teacher that he not only give instruction to his pupils, but that his influence and activities extend outside of the school, reaching the farming population in the community. It is agreed by agricultural educators that, if possible, helpful extension work should be planned which will reach adults outside of the schoolroom, and which will assist in establishing the school work in the estimation of the public. The agricultural teacher therefore needs to be so well informed concerning his subject that he can command not only the respect of pupils, but that of practical farmers of the community.

In order to do this extension work, — to meet the farmers of the community on common ground, — it is evident that the teacher must have, together with his technical knowledge, understanding of practical agriculture. He must be able, if an occasion presents itself, to do farm work in a deft, workmanlike way. If a part of his youth has been spent upon a farm, he will find this experience of great advantage to him in teaching agriculture successfully in a community where general agriculture is practiced. In any case he should have had at least enough actual practice in doing farm work under ordinary farm conditions so that he has skill and ease and ability in farm operations.

If agriculture is to become universally recognized as a

science as well as an art, the agricultural teacher must be thoroughly grounded in science. A knowledge of technical agriculture is not sufficient. The principles of agricultural science have been, and are being, developed through the application of scientific principles in the field of agriculture. They are produced and organized and applied through the study of the chemistry of plant and animal life, the productivity of soils, the culture of certain kinds of plants, animal husbandry, and the like. All knowledge of agriculture as a science must be developed through knowledge of various basic sciences. However, the fact should not be forgotten that this study of science must be accompanied by equally thorough training in technical agriculture.

Just as technical agriculture alone is not sufficient for the agricultural teacher, neither is a thorough knowledge of science sufficient. The weakness of the pure science man as a teacher of agriculture has already been referred to. We have no reason to expect because a man is a scholarly and expert botanist and zoölogist that he will therefore be an equally skillful agriculturist. Without special training there is no likelihood that he will be. With many of the facts concerning plant growth and development which are of great importance to the agriculturist, the botanist has little concern; in many facts concerning animal life, of vital importance to the farmer, the zoölogist has no interest. Both the botanist

and the zoölogist are interested in a multitude of facts and phenomena which have but a passing interest for the agriculturist.

Even when the trained agriculturist and the trained science man take the same subject for presentation and study, there is likely to be a noticeable difference in method because of the difference in point of view.

The agriculturist looks upon his stock of scientific knowledge, and upon the knowledge of nature presented to pupils in the high school sciences, as largely for the purpose of improving upon nature and as a foundation for other knowledge. Too frequently the scientist finds it impossible to take this point of view. He is too much inclined to teach facts for what they are worth as facts of pure science. Moreover, it is difficult for the scientist to gather into synthetic unity the dissociated bits of the subject, when trying to teach agriculture.

In order to secure the habits and knowledge of agricultural science, those that make it really unique and distinguish it from all other fields, there must be special study of the facts and processes that belong to that field. A knowledge of the other sciences, though they may be the basis of agriculture, is not sufficient.

In addition to his scientific and technical training, the agricultural teacher should have as much broad general knowledge as possible. He should be able to recognize the limitations as well as the educational resources of his

specialty. He should understand what his pupils can get from the study of agriculture and what they cannot get. He should know from what courses the pupils can get other needed training.

Too many high school teachers have little appreciation of what should be the right relation of their department to the other departments of the high school. Their ambition is to push their subject to the front, regardless of its comparative value. They seem, sometimes, to desire to crowd out other subjects altogether. They have no idea of relative values.

Every high school teacher, if he is to do the best grade of work, must be able to see his work in relation to that of his fellow teachers and be able to coöperate with them on a basis of mutual understanding to the advantage of the institution as a whole.

Included in his general education, the agricultural teacher needs good training in English and public speaking, as a preparation for the extension or community work which is coming to be an expected part of his duties. For this work, too, some knowledge of economics, especially agricultural economics, will be very valuable. In fact, any studies which put him in touch with the life and activities of the world and help him to understand better the relations of society will be of advantage.

Lastly, the agricultural teacher needs broad general knowledge in order that he may make his work respected

as it should be by his colleagues, by the high school pupils, and by the community.

For no very good reason, there exists at present in many communities and even among educated people, a lack of respect for agriculture as an occupation and a lack of appreciation of the thorough education which a university-trained agriculturist now receives. It is particularly necessary that the high school teacher of agriculture be a man of wide general information and considerable culture if this tide of unfair opinion is to be turned. There is no more reason for the slighting fling at the "farmer's" occupation than for that of the engineer. It is a part of the duty of agricultural teachers to make the kind of work for which they stand respected and dignified.

The teacher of agriculture, as of any other high school subject, needs to have a certain amount of professional knowledge and training, acquired either during the last two years of his university course or in postgraduate study in a good school of education.

One of the greatest hindrances to-day to the progress of agricultural education lies in the fact that so many agricultural teachers have only a student's knowledge of subject matter and are lacking in other essential qualifications of a successful teacher.

Every teacher of agriculture should be well grounded in the social and pedagogical principles and problems

involved in all education. He should have a right point of view as to education in general. His training should include a general study of the past history and present status of educational institutions and the relation of the high school to the elementary school and the university; the aims and organization of work in secondary schools and some comparison of our own with foreign secondary schools; the history of the teaching of agriculture, especially in the elementary and secondary schools; a course in educational psychology, with special emphasis on adolescence; study of the fundamental principles of education, with consideration of educational aims, values, and processes or methods; special study of methods of teaching agricultural subjects in the high school; and a certain amount of experience in instruction and class management with secondary pupils. In addition, some study of school hygiene and of the organization and management of the school system is most desirable.

The high school teacher needs to know something of the history of secondary education in order to understand the present place and work of secondary schools. He needs to know something of our present civilization, social conditions, and the obligations of citizenship in order to understand the work and problems of public education in general and the work, purposes, and special problems of secondary education in particular.

He needs to have a knowledge of the fundamental

facts of psychology and of their educational applications, in order that he may deal wisely with pupils in instruction and general management. Much of the psychology taught in many universities is not directly serviceable to teachers, it is true. It may not be clear as to how some of this information will help in teaching boys and girls. It is perhaps difficult to point out how it can be put to specific daily use in solving particular problems. But that a knowledge of educational psychology is valuable to the teacher, there is no doubt.

Human minds do not work in a lawless way, and the teacher should know the laws of the mind, just as an electrical engineer needs to be familiar with the laws of electricity, before he installs a plant. As a civil engineer who deals with certain materials studies these materials, so the high school teacher should study the general laws governing the working of the minds of boys and girls of the high school age before he attempts to teach them.

He should have a knowledge and appreciation of the processes and laws of mental growth, and should understand the fundamental characteristics of pupils of the adolescent period. If he is to know how to govern pupils, how to enlist and hold attention, how to teach pupils to study, he must understand their mental characteristics and shape student management and instruction in harmony with it.

Supplementing study of educational psychology should come the study of pedagogy. Too often the agricultural teacher knows enough of his subject, but he does not know how to teach it. As a part of his preparation he needs a good general survey of teaching methods for the high school and special knowledge and training in the teaching of his own subject.

Teaching methods for industrial or vocational subjects are quite unlike those adapted to the older high school subjects. Methods for different vocational subjects vary widely. In agricultural teaching particularly a knowledge of special methods for the subject is necessary. For example, the proper management of the work of individual gardens, experimental or problem gardens, and demonstration plots demands a knowledge of special methods of procedure. Each requires a different treatment as a part of the instructional work of the high school. Moreover, the agricultural field is so broad that the prospective teacher needs to make a special study of materials and methods from the viewpoint of the secondary school, that he may be able to segregate from the entire field such materials as will make a suitable course for a given place or a given length of time. He must understand how to adapt his knowledge to the comprehension of high school pupils; how to recast that knowledge to fit the pupil's mind.

Too many young college graduates fail to recognize

the fact that high school students are boys and girls, not grown-up young men and women. They insist on doing special and technical work before their pupils are prepared for it. They do not realize that college materials and methods are not necessarily suited to the high school, and that what was admirable in college instruction may be quite the reverse in the high school. They are too prone to follow the example of their college professors in teaching, since their example is fresh in memory. If this example has been good, the result of their imitation may be fairly satisfactory. But if not, pupils and subject suffer.

In addition to instruction in special teachers' courses in his own subject, the high school agricultural teacher should, if possible, have some opportunity for observation and practice teaching with secondary pupils, under proper supervision. He needs practice in making lesson plans and opportunities to teach under the direction of helpful critics. He needs to acquire, in addition to a knowledge of certain educational principles and rules, good sense in applying those rules, — to be able to judge as to when to enforce a rule and when to disregard it, though it may be an accepted procedure in teaching.

The university-trained agriculturist is not, "ipso facto," a teacher. Nor does he always become a good teacher after he goes out into the high school, by the experience gained there in his work. A few people

may be "born teachers"; but the number is rare. The average person needs training in order to become a good teacher, as much as for any other vocation.

How the agricultural teacher is to get experience and training as a part of his preparation — to acquire skill in teaching — is still a question.

It is asserted by some that every university should have, as a "laboratory" for its education department, a secondary school of observation and practice for students preparing to teach in the high school. But others affirm that we cannot expect the universities to undertake this line of work because of the difficulty of securing support for such schools in students of right quality and number as well as in money. Moreover, it is objected that ordinary high school conditions do not prevail in such schools.

As a substitute, it is suggested that arrangements be made with local high schools for practice work and substituting, the university possibly assisting in paying the salaries of superior teachers for such schools, with the understanding that they supervise the practice work of students and act as critic teachers.

The ideal plan for practice work as a part of a future high school teacher's training is as yet undetermined, though in one way or another a considerable number of colleges are trying to find it. But that the practice teaching should be in schools of secondary rank seems

unquestioned. The suggestion that experience in grades be made a part of a high school teacher's training has not infrequently been made. But the fact that grade pupils are of different age, capacity, and characteristics from high school pupils makes such an arrangement very unsatisfactory.

Finally, the high school agricultural teacher must be of desirable personal qualities. He should have good health, good habits, a well-balanced mind, and an optimistic nature. He should be of strong, sympathetic personality, able to feel and see with his pupils. "Without sympathy a teacher may develop such a spirit of contrariness in his pupils that they will walk to the block and lay down their intellectual heads before they will study for him." He must have imagination, that he may put himself in the position of pupils and look through their eyes. He should have a well-developed sense of humor, enabling him to see and to enjoy the humorous, to enliven the routine of daily school work, and to take the sting out of unpleasant situations. He must be prepared to meet people pleasantly in his community work and to establish agreeable working relations with them; and he must be prepared to maintain harmonious relations with his fellow teachers.

Some people ought never to teach, whatever their training. The man of bad personal habits, bad taste, irritable, gloomy, or narrow in his views of life has no

business in a schoolroom. The universities should see to it that those students who have not the natural traits of a good teacher are urged to take up some other line of work. There are many things besides teaching which an agriculturally trained man can do. If he shows plainly that he is not adapted to the teaching profession, he should be urged to take up some farming occupation, not to go into the high school to teach. Agricultural colleges should not recommend persons to teach unless they have natural ability as teachers, together with a proper amount of technical and professional training.

It is evident that many of the qualifications necessary for the high school agricultural teacher are quite as necessary for other high school teachers; but it is equally clear that a more extended training is required for him than for his colleagues. Moreover, the duties as well as the preparation of an agricultural teacher are greater than those of other high school teachers.

As has been said, it is now recognized that the high school agricultural teacher (as also perhaps the home economics and the manual training teacher) must not only work with students, but that he must be prepared to do a certain amount of community or extension work; that is, work for and among those members of the agricultural community who do not attend school, — the men and women on the farms and the boys and girls who cannot attend school regularly.

The question may be raised as to why such duties should devolve upon the agricultural and other vocational teachers, and not upon the teachers of other subjects. In the first place, even though other departments might wish to help the people of the community, there is little opportunity for them to do so because of their limited equipment along practical lines. Comparatively few persons are interested in the languages, or school mathematics; but all farmers and many others are interested in agriculture. We need comparatively few scholars, but many breadwinners. However, it would undoubtedly be a move in the right direction if the teachers of the so-called cultural subjects should search out the possibilities in extension work along their own lines, inaugurating reading circles, popular literary or historical lecture courses, and the like.

In order to do extension work most effectively, the agricultural teacher must be in keen sympathy with rural needs and welfare; he must give more or less time to special study and investigation of agricultural problems in the locality. He must be thoroughly informed as to all the work of the national government and the state agricultural college and experiment station along lines of interest to farmers of the district; and he should keep in touch with the experiment stations in other states where work is done under conditions similar to those in his own state.

He must be able not only to present a topic to a class, but to take up the agricultural problems of farmers and to help in finding a solution. He must be able to direct and carry on short course work, to direct the work of farmers' institutes, to coöperate with the state experiment station and the national government in carrying on experiments at a school experiment station for the benefit of the locality. He should be able to prepare for publication, in good, clear English, leaflets bearing on the agricultural problems of the district, and to direct their distribution.

He may not do all this, and unless special assistance is given him whereby his classroom work is lightened and financial support is assured, he will be unable to do so; but he should have preparation which fits him to do this kind of work.

In addition to his regular school and extension duties, the agricultural teacher is frequently expected to be on duty practically throughout the year, being responsible for the school farm during the summer vacation period and supervising the summer home project work of students. His vacation, if he has one, is thus necessarily brief; unless there are two or more agricultural teachers in the high school, and arrangements are made whereby they relieve each other at certain times; or unless, as has been suggested (pp. 322–23), it is possible to so arrange the agricultural work of the school as to give the

teacher a winter vacation corresponding to the summer vacation of other teachers.

Having reviewed the qualifications and legitimate duties of the agricultural teacher, the next question is naturally as to where he can receive proper training for his work.[1] In most of the agricultural colleges provision is made for instruction in the history and theory of pedagogy,[2] and in a considerable number special courses are given for students preparing for public school teaching. However, in many cases this preparation is especially for rural or elementary school work.[3] In a few colleges an endeavor is made to prepare students especially for high school agricultural teaching; but the number is very limited. In only one or two instances is there any attempt to give supervised experience in high school practice teaching.

[1] It is perhaps needless to say that persons already teaching agriculture, but inadequately prepared for their work, should, wherever possible, discontinue teaching to prepare themselves fully. Where this is not possible, they should take advantage of summer school or correspondence courses, dealing with the subjects in which they are lacking.

[2] Monahan, A. C., "What is being done to prepare Teachers of Secondary Agriculture," U. S. Bur. of Education Bul., 1912, No. 6, pp. 41–51; U. S. Bur. of Education, Report of the Commissioner, 1910, pp. 256–258; Davis, B. M., "Agricultural Education," chapter 5, University of Chicago Press, 1910.

[3] Except where the teachers are to be supervisors of the work, this seems to be a mistake. For the normal schools can, if they secure properly trained teachers from the agricultural colleges, very well take care of the training in agriculture of the grade or rural school teacher.

Even where adequate training can be secured for secondary agricultural teaching, comparatively few students take the work. Opportunities for trained agriculturists in the commercial world and in practical farming are as yet more attractive than teaching in a high school. The tendency is naturally to emphasize technical training, since it is this that promises the greatest returns.

If agricultural college students are to be induced to take the special professional training needed to fit them for high school work and to engage in teaching, they must be paid salaries which will make the work attractive to them. Otherwise such persons will refuse to enter the schoolroom and will go into the commercial world. If teachers of the desired grade are to be attracted to high school agricultural work, they must be paid salaries commensurate with the experience and training which they have received and the duties they are expected to perform. The agricultural teacher should, obviously, receive a salary greater than that of a mere skilled agriculturist, or that of the ordinary academic trained teacher of history or English. It must be at least as much as would be received in other lines of work open to him.

That it is worth while to pay such salaries to high school teachers of agriculture, there is no doubt. For agricultural work, or vocational work of any kind, the best teachers are needed. Inefficiency is more disastrous

in this than in any other kind of teaching work. From the incompetent teacher, pupils will receive neither satisfactory training in the art of farming nor educative instruction in the science of agriculture. But the value of the services of an efficient agricultural teacher to pupils and to the community is beyond measure. From him pupils receive practical training which enables them to go out and earn a living; and that interest in and understanding of their environment which gives zest to life. Through the work and influence of many such shall industrial education in general and agricultural education in particular "come to its own" and be put on an assured basis of support in the minds of the people.

PRACTICUM

Outline a four-year college course which you consider best suited to the needs of a person preparing to teach agriculture in a high school. Indicate studies for each year and the amount of time (credit hours) to be devoted to each.

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Elements of Agriculture

By G. F. WARREN

Professor of Farm Crops and Farm Management, New York State College of Agriculture, at Cornell University

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The *Elements of Agriculture* is the work of an experienced instructor with the editorial assistance of Professor L. H. Bailey. In both subject matter and method of presentation, the author has carried out as far as possible the recommendations of the committee on methods of teaching agriculture of the Association of American Colleges and Experiment Stations. The laboratory and supplementary work is clearly outlined, there is an abundance of questions for study and review, and — a desideratum too often overlooked in agricultural texts — the reading lists are full and include the most recent publications, a full bibliography being given in the Appendix. There are two hundred text illustrations and fourteen full-page plates. The subject as thus presented does not demand any special preparation on the part of the teacher; the usual knowledge of elementary botany and chemistry, and a fair familiarity with farm operations will suffice to conduct the work.

In addition to its use in high school work, the book is sufficiently exhaustive to be used in normal schools, academies, and for brief courses in colleges, as well as for farmers' reading circles and general library use.

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